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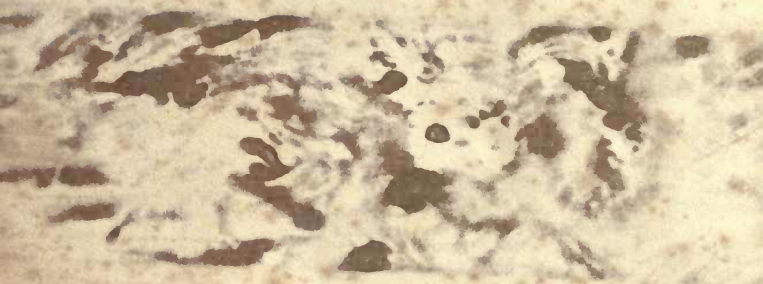
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CORRECTIONS.

On Page 61 and 16th line from the top, for "Iodide of Silver," read *Iodide of Potassium*.

On Page 167 and 2nd line, for "32 ounces," read 64 *ounces*.



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OF THE

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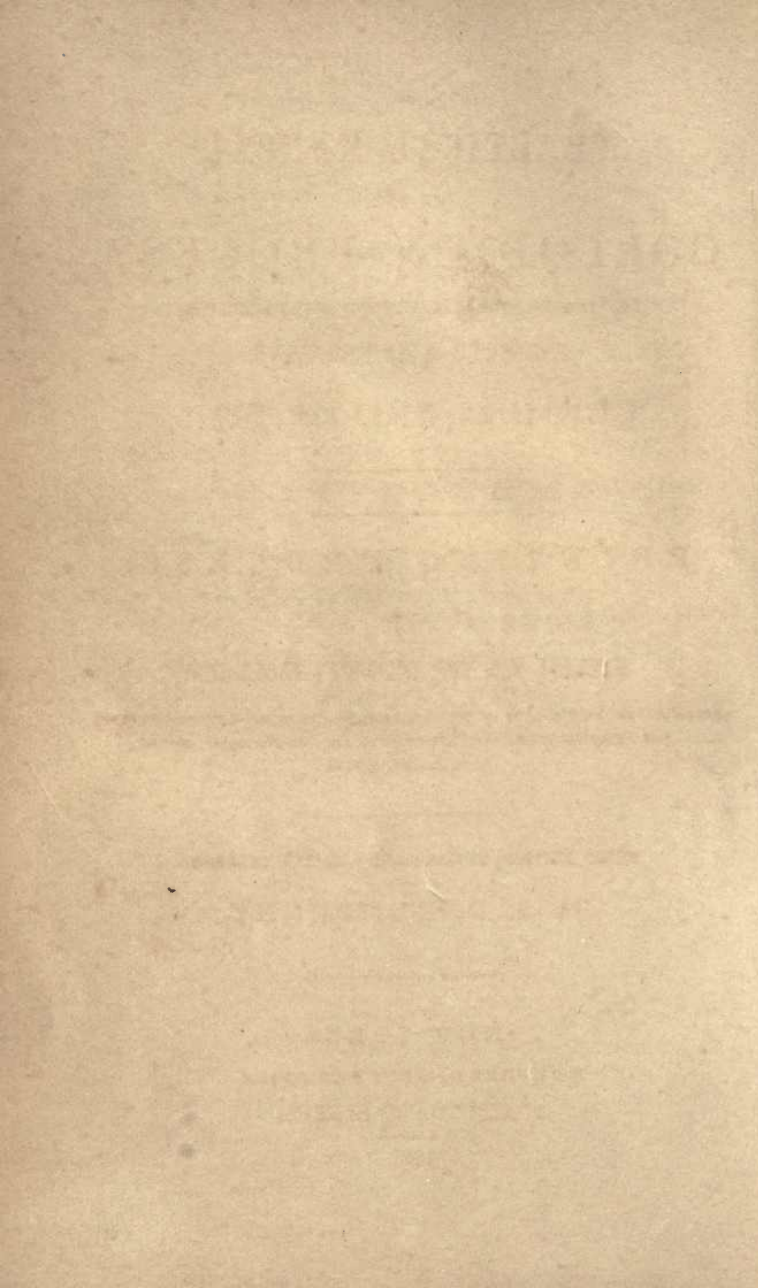
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AND CORRESPONDENCE.—SPECIFICATIONS OF ALL THE FOREGOING, GIVING
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THIRD EDITION, REVISED AND GREATLY ENLARGED.

BY S. D. HUMPHREY.

NEW YORK:

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PREFACE TO THE THIRD EDITION.

The rapid and unexpected sale of the entire second edition of this Manual has induced the author to lay the Third Edition before the Public. Although but little time has elapsed since the second, yet there have been some new developments which it has been thought best to give, as conducive to the interests of the practitioner. The manipulations have been given somewhat more in detail than in the Second Edition.

All that would have a tendency to confuse the reader has been carefully avoided, and only the plain methods for operating laid down. The work is intended for the beginner in the *glass process* of producing Heliographic pictures.

S. D. H.

NEW YORK, *February 1st*, 1857.

PREFACE TO THE FIRST EDITION.

The object of this little MANUAL is to present, in as plain, clear and concise a manner as possible, the *practice* of a COLLODION PROCESS. This beautiful acquisition to "sun-pencilling" was first given to the public by Mr. FREDERICK SCOTT ARCHER, an English gentleman, who alone is entitled to the credit, and deserves the esteem of every lover and practitioner of the Art, for his liberality in *giving* it to the world.

The Process here presented has never before appeared in print, and has been practised with the most eminent success by those who have been enabled to adopt it.

All reference to the various systems or methods of manipulation, by the thousands of practitioners, has been excluded, and *one* Process given. I conceived that this was the better plan to adopt, thus leaving the mind of the learner free from confusion, and pointing out one course, which, if carefully followed, will produce good and pleasing results.

I have also presented a list of all Patents upon the Collodion Process; this will give all an opportunity of choosing their own course in regard to the respect they may conceive to be due to such Patent Rights.

S. D. H.

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CHAPTER I.

LIGHT—SOLAR SPECTRUM—DECOMPOSITION OF LIGHT—
LIGHT, HEAT AND ACTINISM—BLUE PAPER AND COLOR
FOR THE WALLS OF THE OPERATING ROOM—PROPOR-
TIONS OF LIGHT, HEAT AND ACTINISM, COMPOSING A SUN-
BEAM—REFRACTION—REFLECTION—LENSES—COPYING—
SPHERICAL ABERRATION—CHROMATIC ABERRATION.

It has been well observed by an able writer, that it is impossible to trace the path of a sunbeam through our atmosphere without feeling a desire to know its nature, by what power it traverses the immensity of space, and the various modifications it undergoes at the surfaces and the interior of terrestrial substances.

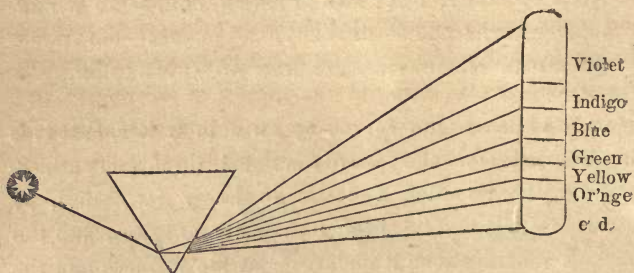
Light is white and colorless, as long as it does not come in contact with matter. When in apposition with any body it suffers variable degrees of decomposition, resulting in color, as, by reflection, dispersion, refraction and unequal absorption.

To Sir I. Newton the world is indebted for proving the compound nature of a ray of white light emitted from the sun. The object of this work is not to engage in an extended theory upon the subject of light, but to recur only to some points of more particular interest to the photographic operator.

The decomposition of a beam of light can be noticed by exposing it to a prism. If, in a dark room, a beam of light

be admitted through a small hole in a shutter, it will form a white round spot upon the place where it falls. If a triangular prism of glass be placed on the inside of the dark room, so that the beam of light falls upon it, it no longer has the same direction, nor does it form a round spot, but an oblong painted image of seven colors—red, orange, yellow, green, blue, indigo, and violet. This is called the solar spectrum, and will be readily understood by reference to the accompanying diagram, Fig. 1.

Fig. 1.



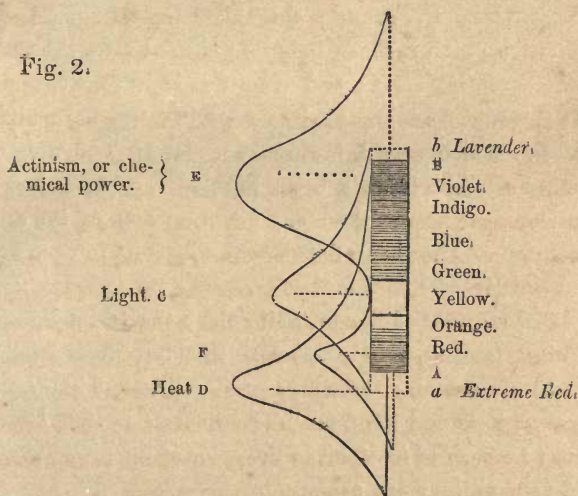
To those who are unacquainted with the theory of light (and for their benefit this chapter is given), it may be a matter of wonder how a beam of light can be divided. This can be understood when I say, that white light is a bundle of colored rays united together, and when so incorporated, they are colorless; but in passing *through* the prism the bond of union is severed, and the colored rays come out *singly* and *separately*, because each ray has a certain amount of refracting (bending) power, peculiar to itself. These rays always hold the same relation to each other, as may be seen by comparing every spectrum or rainbow; there is never any confusion or misplacement.

There are various other means of decomposing white light besides the prism, of which one of the principal and

most interesting to the photographer, is by *reflection* from colored bodies. If a beam of white light falls upon a white surface, it is reflected without change; but if it falls upon a *red* surface, only the red ray is reflected: so also with yellow and other colors; the ray which is reflected corresponds with the color of the object. It is this reflected decomposed light which presents the beautifully colored image we see upon the ground glass in our cameras.

A sunbeam may be capable of three divisions—LIGHT, HEAT, and ACTINISM; the last causes all the chemical changes, and is the acting power upon surfaces prepared to receive the photographic image. The accompanying illustration, Fig. 2, will readily bring to the minds of the reader the relation of these one to another, and their intensities in the different parts of a decomposed sunbeam.

Fig. 2.



The various points of the solar spectrum are represented in the order in which they occur between A and B, this

exhibits the limits of the Newtonian spectrum, corresponding with Fig. 1. Sir John Herschel and Seebeck have shown that there exists, beyond the violet, a faint violet light, or rather a *lavender*, to *b*, which gradually becomes colorless; similarly, red light exists beyond the assigned limits of the red ray to *a*. The greatest amount of actinic power is shown at *E* opposite the violet; hence this color "exerts" the greatest amount of influence in the formation of the photographic image.

(Blue paper and blue color have been somewhat extensively used by our operators in their operating rooms and skylights, in order to facilitate the operation in the camera. I fancy, however, that this plan cannot be productive of as much good as thought by some, from the fact, that the light falling upon the subject, and then reflected into the camera, is, coming through colorless glass, not affected by such rays as may be reflected from the walls of the operating room; and even if it were so, I conceive that it would be injurious, by destroying the harmony of shadows which might otherwise occur.) The greatest amount of white light is at *C*; the yellow contains less of the chemical power than any other portion of the solar spectrum. It has been found that the most intense heat is at the *Extreme Red*, *b*.

Artificial lights differ in their color; the white light of burning charcoal, which is the principal light from candles, oil and gas, contains three rays—red, yellow and blue. The dazzling light emitted from lime intensely heated, known as the *Drummond light*, gives the color of the prism almost as bright as the solar spectrum.

If we expose a prepared collodionized plate or sensitive paper to the solar spectrum, it will be observed that the

luminous power (the yellow) occupies but a small space compared with the influence of heat and chemical power. R. Hunt, in his *Researches on Light*, has presented the following remarks upon the accompanying illustration:—

Fig. 3.

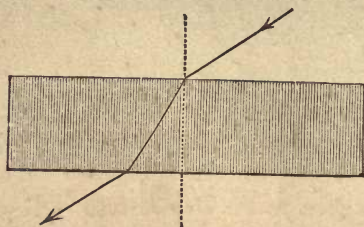


“If the linear measure, or the diameter of a circle which shall include the luminous rays, is 25, that of the calorific spectrum will be 42.10, and of the chemical spectrum 55.10. Such a series of circles may well be used to represent a beam from the sun, which may be regarded as an atom of *Light* surrounded with an invisible atmosphere of *Heat*, and another still more extended, which possesses the remarkable property of producing chemical and molecular change.

A ray of light, in passing obliquely through any medium of uniform density, does not change its course ; but

if it should pass into a denser body, it would turn from a straight line, pursue a less oblique direction, and in a line nearer to a perpendicular to the surface of that body. Water exerts a stronger refracting power than air; and if a ray of light fall upon a body of this fluid its course is changed, as may be seen by reference to Fig. 4. It is

Fig. 4.



observed that it proceeds in a less oblique direction (towards the dotted line), and, on passing on through, leaves the liquid, proceeding in a line parallel to that which it entered. It should be observed, that at the *surface* of bodies the refractive power is exerted, and that the light proceeds in a straight line until leaving the body. The refraction is more or less, and in all cases in proportion as the rays fall more or less obliquely on the refracting surface. It is this law of optics which has given rise to the lenses in our camera tubes, by which means we are enabled to secure a well-delineated representation of any object we choose to picture.

When a ray of light passes from one medium to another, and through that into the first again, if the two refractions be equal, and in opposite directions, no sensible effect will be produced.

The reader may readily comprehend the phenomena of

refraction, by means of light passing through lenses of different curves, by reference to the following diagrams :—

Fig. 5.



Fig 6.

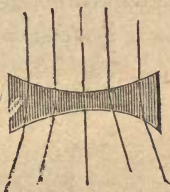


Fig. 7.

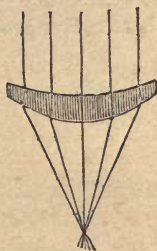
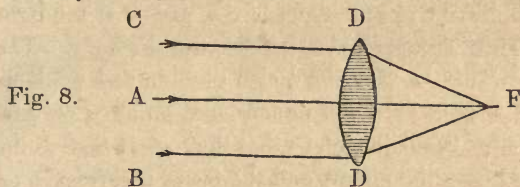


Fig. 5 representing a double-convex lens, Fig. 6 a double-concave, and Fig. 7 a concavo-convex or meniscus. By these it is seen that a double-convex lens tends to condense the rays of light to a focus, a double-concave to scatter them, and a concavo-convex combines both powers.

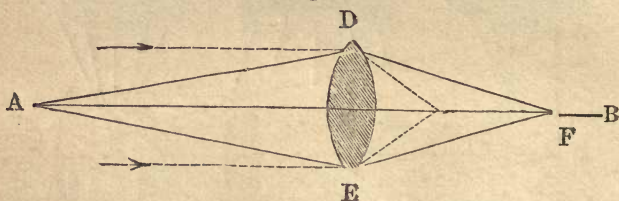
If parallel rays of light fall upon a double-convex lens, D D, Fig. 8, they will be refracted (excepting such as pass directly through the centre) to a point termed the princi-



pal focus. The lines A B C represent parallel rays which pass through the lens D D, and meet at F ; this point being the principal focus, its distance from the lens is called the *focal length*. Those rays of light which are traversing a *parallel* course, when they enter the lens are brought to a focus nearer the lens than others. Hence the difficulty the operator sometimes experiences by not being able to

"obtain a focus," when he wishes to secure a picture of some very distant objects; he does not get his *ground glass near enough to the lenses*. Again, the rays from an object near by may be termed diverging rays. This will be better comprehended by reference to Fig. 9, where it

Fig. 9.



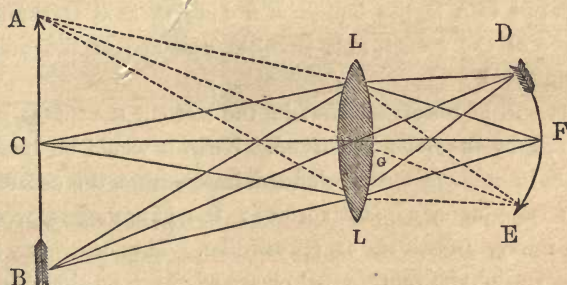
will be seen that the dotted lines, representing parallel rays meet nearer the lenses than those from the point A. The closer the object is to the lenses, the greater will be the divergence. This rule is applicable to copying. Did we wish to copy a $\frac{1}{6}$ size daguerreotype on a $\frac{1}{16}$ size plate, we would place it in such a position to the lenses at A, that the focus would be at F, where the image would be represented at about the proper size. Now, if we should wish to copy the $\frac{1}{6}$ size picture, and produce another of exactly the same dimensions, we have only to bring it nearer to the lenses, so that the lens D E shall be equi-distant from the picture and the focus, *i. e.* from A to B. The reason of this is, that the distance of the picture from the lens, in the last copy, is less than the other, and the divergence has increased, throwing the focus further from the lens.

These remarks have been introduced here as being important for those who may not understand the principles of enlarging or reducing pictures in copying.

I would remark that the points F and A, in Fig. 9, are termed "conjugate foci."

If we hold a double-convex lens opposite any object, we find that an inverted image of that object will be formed on a paper held behind it. To illustrate this more clearly, I will refer to the following wood-cut:—

Fig. 10.



"If A B C is an object placed before a convex lens, L L, every point of it will send forth rays in all directions; but, for the sake of simplicity, suppose only three points to give out rays, one at the top, one at the middle, and one at the bottom; the whole of the rays then that proceed from the point A, and fall on the lens L L, will be refracted and form an image somewhere on the line A G E, which is drawn direct through the centre of the lens; consequently the focus E, produced by the convergence of the rays proceeding from A, must form an image of A, only in a different relative position; the middle point of C, being in a direct line with the axis of the lens, will have its image formed on the axis F, and the rays proceeding from the point B will form an image at D; so that by imagining luminous objects to be made up of an infinite number of radiating points, and the rays from each

individual point, although falling on the whole surface of the lens, to converge again and form a focus or representation of that point from which the rays first emerged, it will be very easy to comprehend how images are formed, and the cause of those images being reversed.

“It must also be evident, that in the two triangles $A G B$ and $D G E$, that $E D$, the length of the image, must be to $A B$, the length of the object, as $G D$, the distance of the image, is to $G B$, the distance of the object from the lens.”

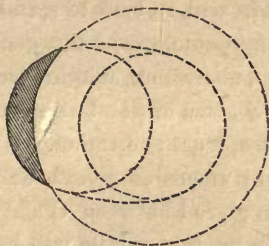
It will be observed, that in the last cut the image produced by the lens is curved. Now, it would be impossible to produce a well-defined image from the centre to the edge upon a *plain* surface; the outer edges would be misty, indistinct, or crayon-like. The centre of the image might be represented clear and sharp on the ground glass, yet this would be far from the case in regard to the outer portions. This is called *spherical aberration*, and to it is due the want of distinctness which is frequently noticed around the edges of pictures taken in the camera. To secure a camera with a *flat, sharp field*, should be the object of every Operator; and, in a measure, this constitutes the great difference in cameras manufactured in this country.

Spherical aberration is overcome by proper care in the formation of the lens:—“It can be shown upon mathematical data that a lens similar to that given in the following diagram—one surface of which is a section of an ellipse, and the other of a circle struck from the furthest of the two foci of that ellipse—produces no aberration.

“At the earliest period of the employment of the camera obscura, a *double-convex* lens was used to produce the image;

but this form was soon abandoned, on account of the spherical aberration so caused. Lenses for the photographic

Fig. 11.

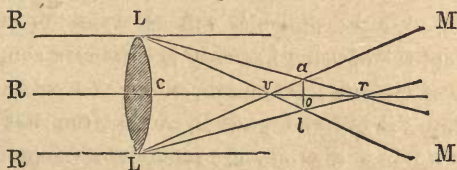


camera are now always ground of a concavo-convex form, or meniscus, which corresponds more nearly to the accompanying diagram."

Chromatic Aberration is another difficulty that opticians have to contend with in the manufacturing of lenses. It will be remembered, that in a former page (14) a beam of light is decomposed by passing through a glass prism giving seven distinct colors—*red, orange, yellow, green, blue, indigo and violet.*

Now, as has been said before, the dissimilar rays having an unequal degree of refrangibility, it will be impossible to obtain a focus by the light passing through a double-convex lens without its being fringed with color. Its effect will be

Fig. 12



readily understood by reference to the accompanying cut.

If L L be a double convex-lens, and R R R parallel rays

of white light, composed of the seven colored rays, each having a different *index* of refraction, they cannot be refracted to one and the same point; the red rays, being the least refrangible, will be bent to r , and the violet rays, being the most refrangible, to v : the distance vr constitutes the chromatic aberration, and the circle, of which the diameter is al , the place or point of mean refraction, and is called the circle of least aberration. If the rays of the sun are refracted by means of a lens, and the image received on a screen placed between C and o , so as to cut the cone $LalL$, a luminous circle will be formed on the paper, only surrounded by a red border, because it is produced by a section of the cone $LalL$, of which the external rays $LalL$, are red; if the screen be moved to the other side of o , the luminous circle will be bordered with violet, because it will be a section of the cone $MamM$, of which the exterior rays are violet. To avoid the influence of spherical aberration, and to render the phenomena of coloration more evident, let an opaque disc be placed over the central portion of the lens, so as to allow the rays only to pass which are at the edge of the glass; a violet image of the sun will then be seen at v , red at r , and, finally, images of all the colors of the spectrum in the intermediate space; consequently, the general image will not only be confused, but clothed with prismatic colors."

To overcome the difficulty arising from the chromatic aberration, the optician has only to employ a combination of lenses of opposite focal length, and cut from glass possessing different refrangible powers, so that the rays of light passing through the one are strongly refracted, and in the other are bent asunder again, reproducing white light.

To the photographer one of the most important features,

requiring his particular attention, is, that he be provided with a good lens. By the remarks given in the preceding pages, he will be enabled, in a measure, to judge of some of the difficulties to which he is *occasionally* subjected. We have in this country but two or three individuals who are giving their attention to the manufacture of lenses, and their construction is such, that they are quite free from the *spherical* or *chromatic* aberration.

CHAPTER II.

CAMERA—ARRANGEMENT OF LENSES—CAMERA TUBES—CAMERA-BOXES, BELLWS, AND COPYING—CAMERA STANDS—HEAD RESTS—CLEANING VICE—NITRATE BATH—LEVELING STANDS—PRINTING FRAMES—COLLODION VIALS.

BABTISTA PORTA, when he saw for the first time, on the walls of his dark chamber, the images of external nature, pictured by a sunbeam which found its way through only a small hole, little thought of the importance which would be attached to the instrument he was, from this cause, led to invent. The camera obscura of this Italian philosopher remained as a mere scientific toy for years, and it was not until Daguerre's discovery that its true value was estimated. It now plays a very important part in giving employment to at least *ten thousand* persons in this country alone.

It is of the utmost importance, in selecting a set of apparatus, to secure a good camera ; for without such no one can obtain fine pictures. In testing it, see that it gives the pupil of the eye and lineaments of the features sharp and distinct ; and that the whole image on the ground glass has a fine pearly hue. Look also to the field, and observe that the focus is good at the centre and extreme edges of the ground glass at the same time. A poor camera generally gives a misty image, with the lights and shades apparently running together. The best American

cameras are fully equal to those imported, while they cost much less; but there are great numbers sold which are not worth using.

If a lens gives a well defined image on the ground glass, it should do the same on the plate. Many a valuable lens has been condemned for failing in this, merely in consequence of the plate-holder not being in focus with the ground-glass. In case of deficiency in this, put a glass into the holder, lay a rule across the face, and measure the distance between them very exactly; measure the ground-glass in the same way, and make the distance agree perfectly, by moving the ground-glass either back or forward in the frame, as the case may be, so that the surface of the glass plate shall occupy precisely the same position as the face of the ground-glass when in the camera.

It is very desirable that the operator should understand the arrangement of the lenses in the tube; it not unfrequently happens, that in taking out the "glasses" to clean them, he does not return them to their proper places, and the result is that his "camera is spoiled." A couple of illustrations and a few remarks will be sufficient to enable any one to replace the lenses in them properly. Fig. 13

Fig. 13.

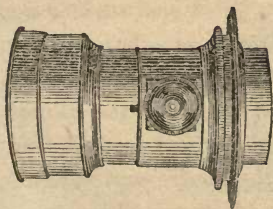
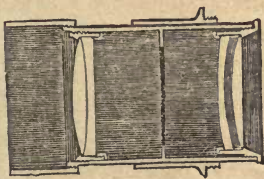


Fig. 14



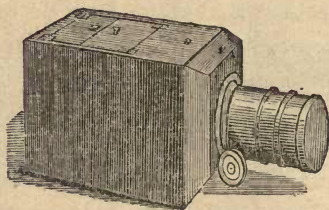
represents the tube for holding the lens, and Fig. 14 shows their arrangement. It will be seen that the two

back lenses have a small space between them ; this separation is kept by a small tube or ring of the same circumference as the lens. The two front lenses are nearest together. It will be observed that the two thick lenses are towards each other ; these are made of *flint glass* containing much oxide of lead. The other two are double convex, and are made of *crown glass*. By noting the fact that the two cemented lenses go in the front of the tube, the glass having the thickest edge goes inside, and that the *thickest lens* of the other two goes in first, from the back of the tube, it will not be easy for the operator to make a mistake in returning the "glasses."

"I will remark that a diaphragm diminishes both chromatic and spherical aberration, by cutting off the outside portion of the lens. It lessens the brilliancy of the image, but improves the distinctness by preventing various rays from interfering with and confusing each other ; it also causes a variety of objects at different distances to be in focus at the same time."

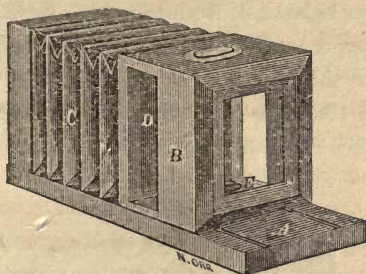
The tube containing the lenses is to be mounted on a box (camera-box) as in Fig. 15. For this purpose there are

Fig. 15.



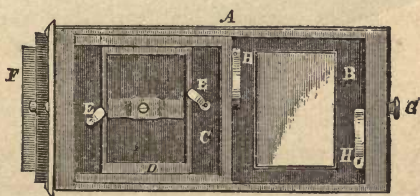
several patterns of boxes, from among which I have made

two selections of the most approved, and represent them by cuts, Figs. 16, 17, 18. [Fig. 16.]



Figs. 16 and 17 represent a bellows-box which is probably more in use than all the other patterns together. They serve both for copying and taking portraits from life. A is

Fig. 17.



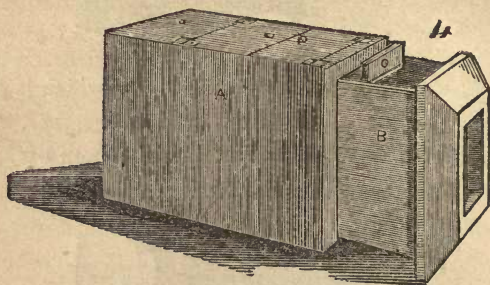
the base ; B is the back and *sliding-box* ; C, bellows, which admits of extension or contraction ; D is the opening to receive the carriage A, Fig. 17 ; E is a thumb screw to hold the sliding-box at any required distance. Fig. 17 represents the plate-holder and ground glass frame.

A, carriage to pass through D, Fig. 16 ; B, frame for ground-glass, which may be turned in a horizontal or perpendicular position ; C, a movable plate-holder held in place by means of springs ; D, reducing holder, with bottom and plate to hold the glass plate : any size of reducing frame can be put in frame C ; E E, spring bottom to keep frame

D in place ; F, slide ; G, thumb-screw, when the carriage is to be put in or taken out of the box, Fig 16 ; H H, spring bottom to hold B in place.

Bellows-boxes can be obtained which receive the plate-holder from the top, the same as in the copying-box, Figs. 15 and 18. The common wood, or "copying-box," is represented by Fig. 18.

Fig 18.



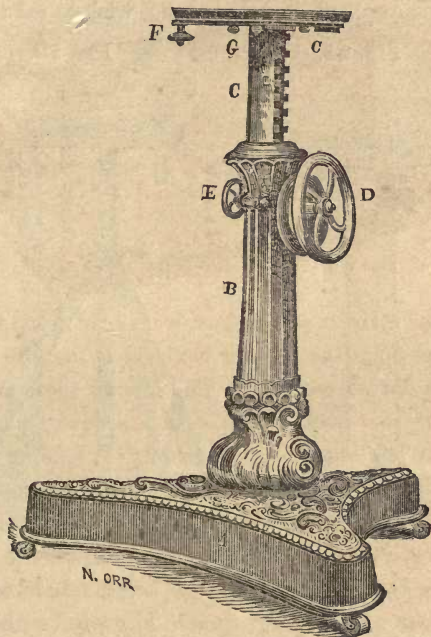
A, being the main or outside box, is made of wood veneered with rosewood ; B is another box which fits into A, sliding in and out as required. The ground glass and plate-holders fit grooves made in the inside box.

In regard to plate-holders or tablets for holding the glass plates, it need only be said that the camera-boxes are accompanied with a complete set, so arranged that the light is wholly excluded from the plate while drawing out or pushing in the slide, for shutting off the light while the holder is out of the box. Should any one be desirous of using the same camera, for taking both glass and daguerreotype pictures, it will be necessary for him to be provided with two sets of tablets for his box, one for each process.

CAMERA STANDS.

There are several patterns of these ; almost every dealer has some particular style, which, if not for beauty, for his interest, suits his purposes best. Among the assortment, I will present only two illustrations. The first, Fig. 19, represents one which has an advantage over many others ; it is made of cast iron, and of an ornamental pat-

Fig. 19.



tern :—A, base on castors ; B, fluted hollow column, which admits the iron tube C, which has on one side a hollow tooth rack to receive a spiral thread on the inner face of wheel D ; this wheel, when turned, elevates or lowers the

tube C to any desired height; E, thumb wheel attached to a screw which sets against tube C, to hold it in position, F, a pinion by which the camera can be directed; G G, thumb screws to hold the two plates together when in position. It is quite heavy, stands *firm* and *solid*, and is not liable to be moved by the jar from walking over the floor. For permanently located operators these are the most desirable; but for those who are moving about from place to place, and those who wish to take views, a

Fig. 21.

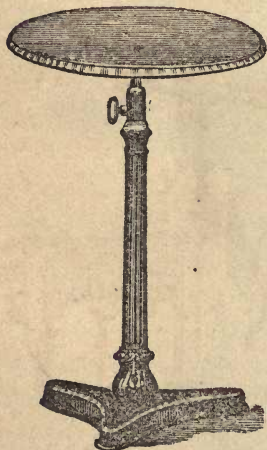
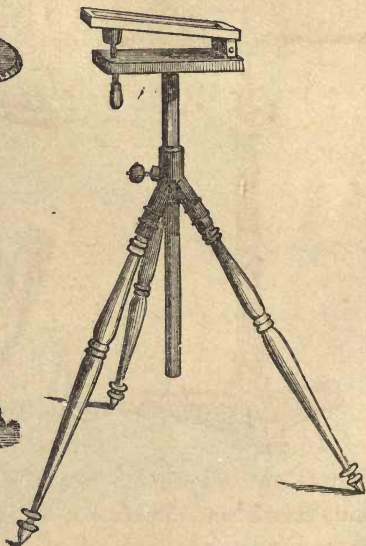


Fig. 20.



lighter article would be more convenient, such as one represented at Fig. 20. This stand is made principally of wood, and can be readily taken apart, so as to be packed in an ordinary sized trunk.

Fig. 21 represents a small "Jenny Lind stand," and is

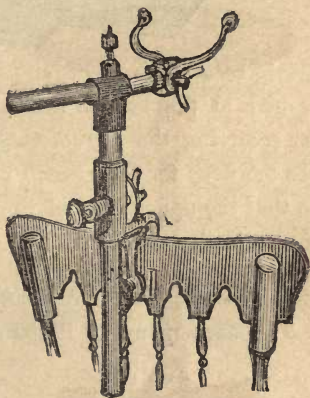
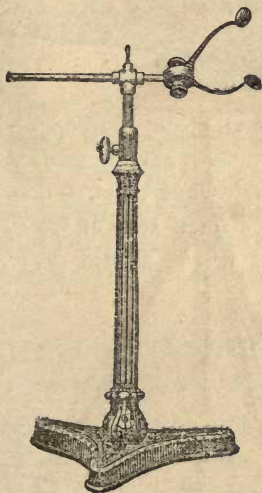
a very convenient article for the sitter to lean a hand or arm upon while sitting for a portrait. It is fixed with a rod for raising or lowering the top, and can be adjusted to any required height.

HEAD RESTS.

There are several patterns of head supports, or, as they are commonly called, head rests, in use by the profession. I give two illustrations (Figs. 22 and 23). The

Fig. 22.

Fig. 23.



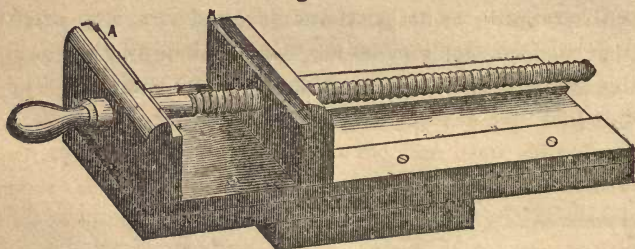
first is an independent iron rest, known as the "Jenny Lind Rest;" and the other is for fastening to the back of a chair, as seen in the cut. For general use, I would recommend the iron independent rest as far more advisable than any other.

VICES FOR HOLDING GLASS.

The article used for holding the glass, during the process of cleaning, is called a vice; and, of the numerous

styles recently introduced, I find none that I would prefer to the old one known in market as "Peck's Vice;" it is simple and easy in operation, and at the same time is effectual. Fig. 24 represents this vice, which is to be

Fig. 24.



firmly secured to a bench; the small piece of wood attached to the bottom is of no use. A A are the grooves for receiving the daguerreotype plate-block; but as they are too deep for the glass, I pin on a small strip of wood, so that the upper edge of the glass will be a little above the projection of the vice.

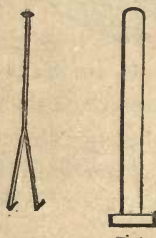
NITRATE BATHS AND DIPPING RODS.

The accompanying illustration, Fig. 25, *a*, represents a

Fig. 25.



Fig. 26. Fig. 27.



bath for holding the nitrate of silver solution. This

shape is of my own suggestion, and the best adapted to the wants of the photographer. It will be seen that the front side is rounding, with a curve extending from side to side. By this shape, the *face* of the glass is protected from coming in contact with the side of the bath—both edges of it turning so as to prevent injury. There is a small projection on the top, at the opposite side of the oval; this is to allow the solution to flow over and wash off any dust that may have gathered upon the surface of the solution. This wash runs out of a small tube, as is shown in the cut. Any convenient vessel can be placed under it to receive the liquid. This can be filtered and returned as often as required. I am not in the practice of filling my baths full of solution, but always keep them filtered and clean; hence saving an excess of solution.

b represents a little support, which is secured at its base upon the shelf, to hold the bath in a slightly inclined position, which is preferable to having it stand perpendicularly.

LEVELING STANDS.

Persons oftentimes require a rest or place to put their

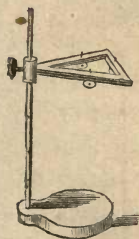


Fig. 29.

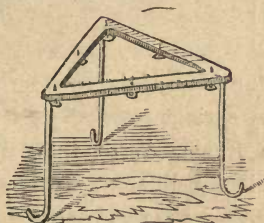
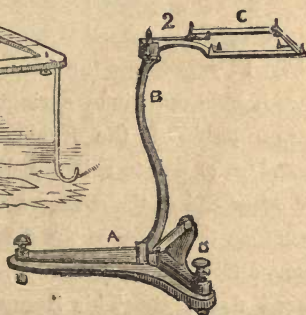


Fig. 30.



glass during development or washing the picture. Either

of the stands represented by the annexed cut will answer the purpose.

Fig. 30 is known to the daguerreotype operator as a "gilding stand," and is the one best adapted to the wants of operators on glass. It may be so arranged as to give the surface of the glass a water-level; D D are thumb-screws, by means of which, when properly regulated, the frame C may hold glass perfectly level and a large quantity of solution may be poured over the surface.

PRINTING FRAMES.

There are numerous methods and apparatus used for holding the negative and the paper during exposure to the light. The following illustrations represent a convenient and economical frame for this purpose.

Fig. 31.

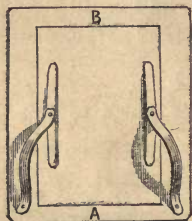


Fig. 32.

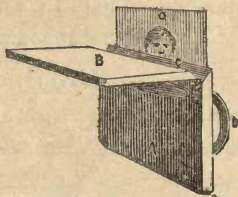


Fig. 31 represents the front of the frame. The negative glass is held upon it by springs attached by screws to the bottom half of the frame, A, so that they can be turned on or off, to suit the different sizes of glass. On the other end of the spring are wooden buttons, which are placed on the edges of the glass negative, holding it in its place, and pressing it firmly against the paper which is placed under it. This frame is made of two pieces of inch board, which are connected by hinges, falling over

as seen in Fig. 32, B being the half that is movable. This movable half is secured in position by means of a wooden button, attached to A on the back and under B, as seen in Fig. 32. The separate pieces, A and B, are bevelled where they connect, as seen by Fig. 31. D (in Fig. 32) is one of the springs, which can be seen in Fig. 31.

The entire bed or face of the frame, A and B, should be covered with a thick piece of satinet cloth, which may be pasted to the lower half, A, and extended over the entire surface of A and B. This forms a pad for the paper.

This printing frame can be easily made by any cabinet-maker or carpenter. The springs may be of sheet iron or brass—either will be found sufficiently stiff for the purpose. Every operator should be provided with from four to ten frames: the saving of time will be found to amply repay the expenditure necessary for a good supply.

Another article called a pressure frame, is represented in

Fig. 33.



the accompanying figure. This is more expensive than the first, and is by some considered preferable.

Another cheap, convenient and equally good arrangement for holding the negative and paper, is to take three glasses—say one a full size, being the one having the negative upon it; and then take two glasses, each just half the size of the negative, and have a piece of *very thick heavy* cloth cut the size of the negative glass, which can be put between it and the two half glasses, and then they can be held together by means of the common spring clothes pin.

The advantage of the two glasses at the back is, that one can be entirely removed while the picture is being examined, and afterwards returned without, in the least, moving the impression.

COLLODION VIAL.—COLOR BOXES.

This shaped vial is made expressly for collodion, to which purpose it is admirably adapted. It has a wide

Fig. 34.



Fig. 35.



mouth, and is so constructed that the liquid flows clear and free. It is deep, and with a heavy protruding base, to prevent its falling. There are two sizes made at present, one to contain $2\frac{1}{2}$ ounces—the other, $1\frac{1}{2}$ ounce. I generally use the smaller ones, but always keep on hand, and would not be without, a few of the larger size.

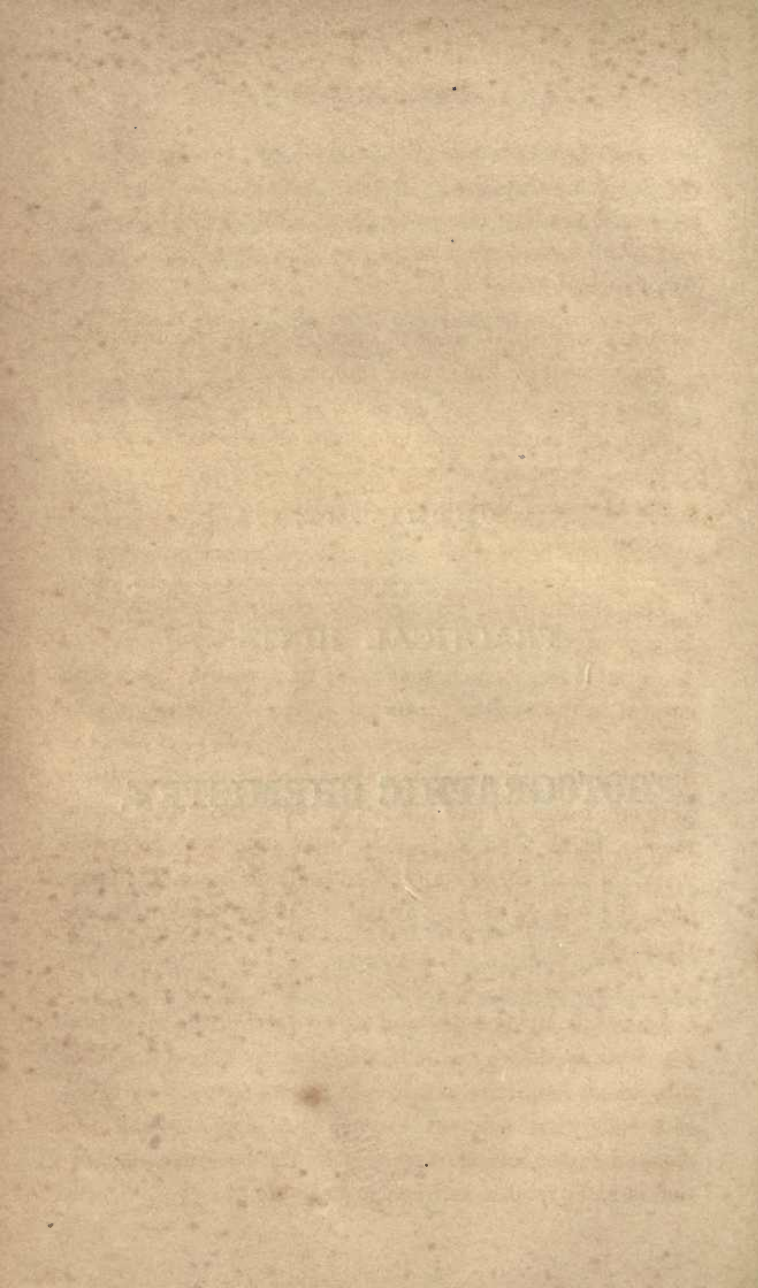
Fig. 35 represents a color-box. These can be had of any dealer, completely fitted, with color and brushes for use.

CHEMISTRY.

PRACTICAL HINTS

ON

PHOTOGRAPHIC CHEMISTRY.



CHAPTER III.

SOLUBLE COTTON — MANIPULATION — PLAIN COLLODION —
BROMO-IODIZED COLLODION FOR POSITIVES — DITTO FOR
NEGATIVES — SOLUTION OF BROMIDE AND IODIDE OF POTAS-
SIUM AND SILVER — DOUBLE IODIDE OF POTASSIUM AND SIL-
VER — DEVELOPING SOLUTION — FIXING THE SOLUTION —
BRIGHTENING AND FINISHING THE IMAGE — PHOTOGRAPHIC
CHEMICALS.

The chemistry of Photography requires the attention, in a greater or less degree, of every practitioner. It is of the utmost importance, that those who wish to meet with success in the various processes given, should not only be provided with a good selection of chemicals, but also understand the nature of the agent employed. To give a perfectly complete and full list of every agent used would require more time and space than can be given in this work. I shall confine myself to some of the most important, and to such articles as are of the greatest interest to the practitioner.

SOLUBLE COTTON.

I have, in my practice and trade, adopted the term *soluble cotton* as the one most appropriate, making a desirable distinction from the article sold as *gun cotton*, they being of a somewhat different nature—gun cotton being the most explosive and least soluble, while the other preparation is more soluble and less explosive.

There are two methods employed in the preparation of soluble cotton ; one being by the use of nitric and sulphuric acids, and the other with sulphuric acid and nitrate of potash. The last of these I would recommend as being the most convenient for those who require only a small quantity of cotton. Persons experimenting in the preparation of this article should exercise much care and judgment. A good cotton is not the result of hap-hazard operation. The operator should be acquainted, as nearly as possible, with the quality of the chemicals employed, and the proper mode of manipulation.

Articles necessary.—One quart Wedgewood mortar and pestle, or evaporating dish ; one glass rod ; one pane of glass, large enough to cover the mortar or dish ; one ordinary-sized pail two-thirds full of pure rain or distilled water, and at least ten times that quantity of water at hand ; twelve ounces (by weight, avoirdupois) of nitrate of potash (Dupont's refined, pulverized) ; twelve ounces (by measure) of commercial sulphuric acid ; and three hundred and forty grains of clean, pure cotton wool.

Remarks.—It is advisable that the mortar or dish be deep and narrow, as the mixture can be better formed in a vessel of this shape. If not convenient to procure a mortar, a common earthen bowl will answer ; glass is objectionable, as the heat generated in the combination of the acid and nitre is liable to crack it. A new pail should not be used, especially if it is painted, as the acids attack the paint, and injure the cotton. I prefer one that has been used for some time, and has been frequently cleaned. A common earthen wash-bowl, or any large glass dish, will answer in place of the pail. Metal pails or vessels should not be used.

Nitrate of Potash (saltpetre) should be dry and finely powdered. I use none other than Dupont's refined; this is very nearly, if not absolutely, chemically pure.

The commercial *Sulphuric Acid* (oil of vitriol) of America is of great uniformity of strength, as sold by druggists generally. I use a test-bulb graduated to the proper density, and have been very successful in my experiments.

In some twenty different samples of acid, used in different cities in the United States, I found only one that produced a poor cotton, and this might have been influenced by the moisture of the atmosphere, it being a very rainy day when I used it.

During my recent and somewhat extensive practice, I have thought that the *fine long fibres* of cotton wool do not make so desirable a soluble cotton as that which is heavy or common. Four or five very careful experiments upon this point, have had the effect to produce in me a strong belief that my ideas are entitled to some consideration. I should not select the *finest* cotton for making soluble cotton, but now invariably take that which is *thick* or *coarse*.

The result of my experience is (other things being equal), that cotton prepared in fine dry weather has a greater degree of solubility than when prepared in a moist atmosphere: hence I would recommend the experimenter to choose fine, clear weather for preparing it.

Manipulation.

Having at hand every article requisite, proceed as follows:—Put the nitrate of potash into the mortar or dish; be sure it is dry and well powdered, and then add the acid; stir them well with the pestle and glass rod, so that

the lumps will be all (or nearly so) out, and a pasty solution formed. This operation should not occupy more than two minutes' time. Then put in the cotton, about one-quarter of the whole bulk at a time : it should be well picked apart, so that it may come immediately in contact with the acids, and should be *kneaded*, with the pestle and glass rod, into the solution, and as soon as wetted, another quarter should be added and wetted as soon as possible ; so continue until all is in : then *knead* with the pestle and mortar for at least four minutes, or until every fibre of the cotton is *saturated* with the liquid ; then the mortar should be covered over with the pane of glass, and allowed to stand for fifteen or twenty minutes ; then the entire contents of the mortar should be thrown into the pail two-thirds full of water, and stirred with the glass rod as rapidly as possible : if this rapid stirring is omitted, the cotton will be injured by the action of the acids in combining with the water. The water should be poured off, and another change put into the pail.

After about three changes, the hands may be used in the farther washing. The hands should be perfectly clean, and free from *all chemicals*. The changes of water and washing should be continued until every trace of acid has disappeared, which can be seen by testing with blue litmus test-paper. After it is thought that the cotton has become free, the water may be squeezed out of a little lump about the size of a pea, and then placed between the fold of the test-paper, and if it reddens the paper, there is acid present, and the washing should be continued until there is no change in the paper. When this is done, the cotton can be put into the folds of a dry towel or cloth (which has been thoroughly rinsed, so that no soap be present), and wrung out as dry as possible, and then it may

be picked apart and put aside, exposed to a moderate temperature (say 100° Fah.) to dry, when it is ready for use.

I employ the method (for convenience, nothing more) of displacing the water by the use of alcohol. [*Cutting's patent—see patents.*] I wring out the water as before, then place the cotton in strong alcohol, stir and press it, and then pour it off; wring it out again, then put it in a change of alcohol, let it soak for about five minutes, then wring it out as dry as possible, pick it apart, and it will dry immediately, and place it in a close stoppered bottle; or, if wanted for use at once, put it into the dissolving solution immediately.

I will here remark that, since the first edition, I have had occasion to use large quantities of soluble cotton, and have found that if it be kept in an atmosphere of alcohol and ether, its solubility is somewhat improved: that is, in the case of its not being used immediately after its preparation. This is easily kept, by dropping a few drops of ether or alcohol into the bottle containing it, and then sealing close until wanted for use. In the event of the water being displaced by alcohol, it is not necessary to thoroughly dry it, but put in a *perfectly close* bottle to keep.

Remarks.—There are a few precautions necessary to be observed in the preparation of soluble cotton. I should select a fine clear day, if time is no object; nevertheless I have made a good article in a moderately dense atmosphere. Sulphuric acid has a powerful affinity for hydrogen, consequently, in damp weather, it is more or less reduced by the moisture in the air.

It is advisable to prepare the nitro-sulphuric acid mixture on a roof, or between two doors or windows, where there is a good current of air, in order to prevent the inhalation of white vapors which arise, and are very poi-

sonous to the lungs. As a preventive, in case of inhaling these vapors, I apply the fumes of aqua-ammonia. It is best for every one to have six or eight ounces of this always at hand; it neutralizes all acid that may be spattered on the clothes, prevents its destructive powers, and restores the color.

Yellow vapors sometimes appear when putting the cotton in contact with the solution: this arises from its not being wet; and when they do appear, the cotton where they are should be quickly put under the liquid and kneaded rapidly, which will prevent a continuance of these vapors. I have had them appear, and used the cotton, and could not observe that any bad effect had been produced.

The temperature is worthy the attention of the operator: if it be low, as in winter, and the cotton be left in the nitro-sulphuric mixture for fifteen or twenty minutes, the whole becomes a thick, stiff mass, bedded together, and has not had proper action, giving a bad article. A good temperature is about 140° Fah. for the last of the time the cotton is in the mixture. This is not always convenient; so the operator will be governed by circumstances, taking his chance of having a good article. In some cases I have heated a *thick* iron plate, at a moderate temperature, placing the mortar upon it, and thus aided in regulating the temperature. This is the most convenient method I have employed.

It has been thought advisable to publish in full the account of Edw. Ash Hadow's experiments and investigations upon the subject of soluble cotton. The following is an account of them as it appeared in *Humphrey's Journal*, vol. VI. p. 12:—

“Having, in my earlier experiments on the collodion pro-

cess of photography, experienced some difficulty in always producing a collodion of uniform quality with regard to sensitiveness, tenacity and fluidity, although making use of the same materials for its preparation, and this I find being the complaint of many others, it has been my study lately to determine the variations in quality to which the ingredients are liable, and the effects of these variations on the sensitive film, and likewise to ascertain whether the excellent qualities of some samples of collodion depend on the materials in ordinary use, or on some substances accidentally or intentionally added. Researches in the preparation of collodion may appear superfluous, now that it is supplied of the best quality by so many makers; but as some persons of an independent turn of mind still prefer manufacturing their own, I venture to bring forward the subject with the hope of benefiting them. In this beautiful process so much depends for success on the quality of the collodion, that when in possession of a good specimen, it becomes one of the easiest and most simple, and ought to be the most certain of all the processes yet devised; for here no material of uncertain composition is introduced, such as paper, and thus we have nothing to fear from plaster of Paris, alumina, or specks of iron or copper, which continually endanger or modify the calotype process; each ingredient can and ought to be obtained in a state of perfect purity, and with this precaution the degree of success depends upon the skill of the operator himself.

Of all the substances used in this process, the gun-cotton is usually the only one actually prepared by the operator himself; in this he cannot fail to have observed the great variations in the solubility, and, when dissolved, the

transparency and tenacity of the films, to which it is liable ; the various processes also that are given appear at first sight unaccountably different, some directing ten minutes, others a few seconds immersion. In consequence of this I have specially examined into the cause of all these variations, with a view to obtain certainty, and also have endeavored to discover how far they affect the sensitiveness of the prepared surface. If we take a mixture of the strongest nitric and sulphuric acids and immerse as much cotton as can be wetted, after some minutes squeeze out the acid as far as possible, then immerse a second portion of cotton, and again express the acids for a third portion of cotton, and so on until the liquid is exhausted, we shall find, on comparing the cottons thus treated, after washing and drying, that there is a gradual alteration in their properties, the first being highly and perfectly explosive, and each succeeding portion less so, until the portion last immersed will be found hardly explosive, leaving distinct traces of charcoal or soot when burned. This may not appear surprising at first sight, as it may be imagined that the latter portions are only a mixture of gun-cotton and common cotton ; this is, however, not the case, for if each quantity be immersed sufficiently long, it will not contain a fibre of common cotton, and may yet become charred on burning like unaltered cotton. The most remarkable difference, however, is discovered on treating them with ether containing a little alcohol, when, contrary to what might have been anticipated, the first or strongest gun-cotton remains untouched, while the latter portions dissolve with the utmost ease, without leaving a trace behind, which alone is sufficient proof that no unaltered cotton remains. This difference in properties is owing to the gra-

dual weakening of the acid mixture, in consequence of the nitric acid being removed by the cotton, with which it becomes intimately combined, at the same time that the latter gives out a proportionate quantity of water. In consequence of these experiments, a great many mixtures of these acids were prepared of various strengths, each being accurately known, both to determine whether there were more than one kind of *soluble* gun-cotton, and, if there were, to ascertain exactly the mixture required to produce the most suitable to photographic purposes. By this means, and by, what I believe has not been pointed out, *varying the temperature*, at least five varieties were obtained;—first, gun-cotton, properly so called, as before stated, quite insoluble in any mixture of alcohol and sulphuric ether. Secondly, an explosive cotton, likewise insoluble, but differing chemically from the first, obtained by a mixture of certain strength when used *cold*. If *warm*, however, either from the heat produced spontaneously on mixing the two acids; or by raising the temperature artificially to about 130° , the cotton then immersed becomes perfectly soluble, producing a third variety; if, however, it be *thoroughly dried*, it becomes in a great measure insoluble. The fourth is obtained by the use of weaker acids used cold, and the fifth when the mixture has been warmed to 130° previous to the immersion of the cotton; in either of the two last cases the product is perfectly soluble, but there is a remarkable difference between their properties, for on dissolving 6 grains of each in 1 ounce of ether, the cotton treated with *warm* acids gives a perfectly fluid solution (which is likewise the case with the third variety produced by acids something stronger), while that obtained by the use of cold acids makes a mixture as thick as castor-oil.

“Having obtained these more strongly marked varieties, as well as intermediate kinds, with all gradations of solubility, it was necessary, before I could select any particular formula for preparing the cotton, to compare their photographic properties, with especial reference to sensitiveness, opacity of the reduced silver in negatives, and its color in positives. A certain weight of each being dissolved in a portion of the same mixture of alcohol and ether previously iodized, the comparison was made, by taking the same objects with each collodion in succession, and likewise by pouring two samples on the same plate of glass, and thus exposing them in the camera together, side by side; this last proved to be much the most satisfactory plan, and was repeated many times for each sample, taking care to reverse the order in which they were poured on, that there might be no mistake arising from the difference of time elapsing between the pouring on of the collodion and its immersion in the sensitive bath. By these experiments I had confidentially hoped to have solved the question as to the cause of difference in sensitiveness and other photographic properties of collodion; but in this I was disappointed, for, after repeated experiments, I believe I may safely affirm that they are precisely similar as regards their photographic properties. The same I believe may be said of Swedish paper collodion, judging from a few comparative experiments I have made, and indeed it is difficult to discover what is the superiority of this material over clean cotton-wool; the ease of manipulation which some allege is a matter of taste, but I should decidedly prefer the open texture of cotton to that of a substance like filtering paper, composed of a mass of compacted fibres, the innermost of which are only reached

when the acids have undergone a certain degree of weakening by the water abstracted from the outer fibres; and when we consider that from cotton alone we have the means of preparing all varieties of collodion, from the most powerfully contracting and transparent to the weakest and most opaque, and each if required with equal and perfect certainty, there appears to be choice enough without resorting to another material, differing only in being more rare and more difficult to procure. But, although the photographic properties of these varieties of collodion-wool are so similar, other circumstances, such as fluidity, tenacity, and transparency, render its preparation of some importance, and indicate that the acid mixture should always be used warm; and it is chiefly in consequence of this very circumstance, that greater success attends the use of nitrate of potash and sulphuric acid than that of mixed acids; for the former when mixed, produce the required temperature, and must be used while warm, since on cooling the mixture becomes solid, whereas acids when mixed do not usually produce so high a temperature, and being fluid can be used at any subsequent period; another obstacle to their use is the great uncertainty of the strength of the nitric acid found in the shops, requiring a variation in the amount of sulphuric acid to be added, which would have to be determined by calculation or many troublesome trials. When a proper mixture is obtained, the TIME of immersion is of no importance, provided it be not too short, and the temperature be maintained at about 120° or 130° ; ten minutes is generally sufficient; (though ten hours would not render the cotton less soluble, as is sometimes asserted.)

“In using the mixed acids, the limits are the nitric acid

being too strong, in which case the product is insoluble, or too weak, when the cotton becomes immediately matted or even dissolved, if the mixture is warm. I have availed myself of these facts in order to produce collodion-wool by the use of acids, without the trouble of calculating the proper mixture according to their strength. Five parts by measure of sulphuric acid, and four of nitric acid of specific gravity not lower than 1.4, are mixed in an earthenware or thin glass vessel capable of standing heat; small portions of water are added gradually (by half drachms at a time, supposing two ounces to have been mixed,) testing after each addition by immersion of a small portion of cotton; the addition of water is continued until a FRESH piece of cotton is found to contract and dissolve on immersing; when this takes place, add half the quantity of sulphuric acid previously used, and (if the temperature does not exceed 130° , in which case it must be allowed to cool to that point,) immerse as much cotton, well pulled out, as can be easily and perfectly soaked; it is to be left in for ten minutes, taking care that the mixture does not become cold, and then transferred to cold water, and thoroughly washed; this is a matter of much importance, and should be performed at first by changing the water many times, until it ceases to taste acid, and then treating it with boiling rain-water until the color of blue litmus remains unchanged; the freedom from all trace of acid is insured by adding a little ammonia before the last washing. Cotton thus prepared should dissolve perfectly and instantaneously in ether containing a little alcohol, without leaving a fibre behind, and the film it produces be of the greatest strength and transparency, being what M. Gaudin terms 'rich in gun-cotton.'

The mixture of nitrate of potash and sulphuric acid is defective chiefly from the want of fluidity, in consequence of which the cotton is less perfectly acted on; this may be remedied by increasing the amount of sulphuric acid, at the same time adding a little water; a mixture of 5 parts of dried nitre, with 10 of sulphuric acid, by weight, together with 1 of water, produces a much better collodion wool than the ordinary mixture of 1 of nitre with $1\frac{1}{2}$ of sulphuric acid. The nitre is *dried* before weighing, in order that its amount, as well as that of the water contained in the mixture, may be definite in quantity; it is then finely powdered, mixed with the water, and the sulphuric acid added; the cotton is immersed while the mixture is hot, and afterwards washed with greater care even than is required when pure acids are used, on account of the difficulty of getting rid of all the bisulphate of potash that adheres to the fibres, which both acts as an acid and likewise causes the collodion to appear opalescent when held up to the light; whereas the solution should be perfectly transparent."

PLAIN COLLODION.

To dissolve the soluble cotton (pyroxyline), and form plain collodion, proceed as follows:

Take of

Sulphuric ether (concentrated),	-	-	10 ounces
Alcohol, from 90 to 95 per cent.,	-	-	6 "

Soluble cotton enough to give the solution a consistency such as will allow it to flow evenly over the surface of the

glass, and impart to it quite a thick and transparent coating. If the coating is opaque, the cotton has not been properly prepared, the acid mixture has been too weak.

Remarks.—It is desirable for every operator to use chemicals of uniform strength, and the better method to adopt is to employ those purchased from some *one* respectable manufactory, and not take those furnished by irresponsible and unconscientious parties. At least one-half of the failures experienced by beginners is from want of good chemicals. It is not economy to purchase a *cheap article*.

Alcohol is an article that can be procured in almost any small village in the United States, and is in general fit for collodion purposes. I have used 88 per cent. in the above proportions, also the intermediate varieties to 98 per cent., and have been quite successful; but feel convinced that the ordinary 98, as marked (which usually stands by actual test 95 to 97 per cent.), is preferable, except in cases where water is employed in dissolving the iodizing salts, when I would use fully 98 per cent.

Before concluding the subject on plain collodion, I will introduce the account given by Mr. E. A. Hadow of his interesting and valuable experiments, as published in *Humphrey's Journal*, Vol. VI, page 18.

“Having obtained good collodion-wool, the next point of inquiry was with regard to the solvent; to ascertain whether the addition of alcohol beyond what is necessary to cause the solution of the gun-cotton in ether, were beneficial or otherwise. For this purpose ether and alcohol were prepared perfectly pure, and mixtures were made of 1 of alcohol to 7 of ether, 2 to 6, 3 to 5, 4 to 4 and 5 to 3. In one ounce of each were dissolved 6 grains of gun-cotton and 4 grains of iodide of ammonium (iodide of potassium

could not be employed, since it requires a certain amount both of water and alcohol to keep it in solution); they were then compared, using a 35-grain solution of nitrate of silver, both by pouring on separate glasses, and likewise by covering two halves of a plate with two samples, as in examining the gun cottons, thus placing them under the same circumstances during the same time; in this way the effect of adding alcohol was very clearly perceived, since the difference between the collodions was much greater than could have been anticipated.

“The first mixture containing only $\frac{1}{8}$ th of alcohol was quite unfit for photographic purposes, from its being almost impossible, even with the most rapid immersion, to obtain a film of uniform sensitiveness and opacity throughout, the surface generally exhibiting nearly transparent bands, having an iridescent appearance by reflected light.

“The second mixture with $\frac{1}{4}$ th of the alcohol is liable to great uncertainty, for if there be any delay in pouring off the collodion the same appearances are seen as in the first, and like it the surface is very insensitive to light, while if the plate be rapidly plunged in the bath, the collodion film becomes much more opaque than before, and is then very sensitive.

“The third proportion of 3 of alcohol to 5 of ether is decidedly the best, giving without the least difficulty a beautifully uniform and highly sensitive film, at the same time perfectly tough and easily removable from the glass if required. A further addition of alcohol, as in the two last collodions, was not attended with any corresponding advantage or increase of sensitiveness; on the contrary, the large proportion of alcohol rendered them less fluid, though with a smaller quantity of gun cotton they would produce very

good collodions, capable of giving fine films : the cause of the weakness of the film, observed on adding much of the ordinary alcohol, is the large amount of water it usually contains.

“ This surprising improvement, caused by the addition of a certain quantity of alcohol, is referable to causes partly chemical, partly mechanical, for, on examining the films, it will be found in the first, and occasionally in the second collodion, that the iodide of silver is formed on the surface, and can be removed entirely by friction without destroying the transparent collodion film below, while in those collodions that contain more than one-fourth of alcohol, the iodide of silver is wholly in the substance, and in this state possesses the utmost sensitiveness.

“ This difference of condition is owing to the very sparing solubility of ether in water, which in the first case prevents the entrance of the nitrate of silver into the film, consequently the iodide and silver solutions meet on the surface ; but on addition of alcohol, its solubility enables the two to interchange places, and thus the iodide of silver is precipitated throughout the substance in a state of the utmost division. This difference is clearly seen under the microscope, the precipitate being clotted in the one case, while in the other the particles are hardly discoverable from their fineness.

“ The presence of a little water considerably modifies these results, since it in some degree supplies the place of alcohol, and is so far useful ; but in other respects it is injurious, for, accumulating in quantity, if the collodion is often used, it makes the film weak and gelatinous, and what is worse, full of minute cracks on drying, which is never the case when pure ether and alcohol are used.

Since the ether of the shops almost always contains alcohol, and frequently water, it is important to ascertain their amount before employing it for the preparation of collodion; the quantity of alcohol may be easily ascertained by agitating the ether in a graduated measure glass (a minim glass does very well) with half its bulk of a *saturated* solution of chloride of calcium; this should be poured in first, its height noted, and the ether then poured on its surface, the thumb then placed on the top, and the two agitated together; when separated, the increase of bulk acquired by the chloride of calcium indicates the quantity of alcohol present, and for this allowance should be made, in the addition of alcohol afterwards to the collodion.

“Water is readily detected, either in ether or alcohol by allowing a drop to fall into spirits of turpentine, with which they ought to mix without turbidity; this is immediately produced if they contain water: for detecting water in *alcohol*, benzole is a more delicate re-agent than spirits of turpentine (Chemist, xxix, 203). It is also necessary that ether should be free from a remarkable property it acquires by long keeping, of decomposing iodides and setting free iodine, which thus gives the collodion a brown color; the same property may be developed in any ether, as Schonbein discovered by introducing a red hot wire into the vapor in the upper portion of a bottle containing a little ether and water; if it be then shaken up and a solution of iodide poured in, the whole rapidly becomes brown; this re-action is very remarkable and difficult to explain for even a mixture of the ether and nitric acid fails to produce a color *immediately*. Ether thus affected can only be deprived of this property by rectification with caustic potash.”

BROMO-IODIZED COLLODION FOR POSITIVES.—No. 1.

One very important object in connection with this part of the collodion process is to have chemicals of a good quality, and always employ those of a fixed standard.

Plain collodion,	-	-	-	-	10 ounces.
Solution of bromide, and iodide of potassium and silver, (page 61)	-	-	-	-	3 drachms.
Iodide of ammonium,	-	-	-	-	10 grains.
Hydro-bromic acid	-	-	-	-	6 drops.

Double iodide of potassium and silver (see page 62) enough so that when the plate comes from the nitrate of silver bath, it will have an opaque cream color.

Remarks.—In the preparation of this sensitive collodion, it is necessary to be cautious and not add too much of the iodide of potassium and silver, for in that case the coating would flake off, and falling into the silvering solution, the operator would be obliged to filter it before he could silver his plate with safety as regards spotting it.

The method I employ is to add the plain collodion, bromide and iodide of potassium and silver, iodide of ammonium and hydro-bromic acid, and then cautiously add the double iodide of potassium and silver from five to ten drops at a time, trying the collodion from time to time by pouring a little on a narrow strip of glass, which I dip into the silvering solution, and let it remain for two minutes. If the coating assumes the proper color (a cream color), I shake the contents of the bottle, and then stand it aside to settle: it is better after it has stood for a week or two.

This collodion I have used after it has been made eight months, and produced fine and satisfactory results, and use

this nearly altogether in practice. Since the first edition of this work has been issued, I have sold over two thousand pounds of this preparation, and the demand is on the increase. I will append another preparation (No. 2) which I have successfully employed, and some operators prefer.

BROMO-IODIZED COLLODION FOR POSITIVES.—No. 2.

Plain collodion	-	-	-	10 ounces.
Iodide of potassium	-	-	-	30 grains.
Bromide of ammonium	-	-	-	20 “

Enough of the double iodide of potassium and silver to give the coating a cream color when it comes from the silvering solution. It will take from one to three drachms. Or this last may be omitted, and a few drops of a saturated solution of dry iodine in alcohol may be added. Either of these plans have been successful in my practice.

Remarks.—The iodide of potassium being insoluble in the collodion, it should be first dissolved in as little water as possible; *i. e.*, take the quantity, 30 grains, put it into a one-ounce graduate, and with a glass rod stir it, adding water, drop by drop, only until all of the salt is dissolved. Then it may be poured into the collodion, and there will be a white powdery precipitate.

The bromide of ammonium will dissolve in the collodion, and can be put into it. When all of the accelerators are in, it should be well shaken, and then allowed to settle and become clear. When wanted, a sufficient quantity may be poured into a vial (see Fig. 34) for use, and the main or stock bottle should not be disturbed oftener than necessary. This last collodion is not as durable as the first, but is less trouble to prepare.

BROMO-IODIZED COLLODION FOR NEGATIVES.

Plain collodion	-	-	-	-	8 ounces.
Iodide of potassium (dissolved as per page 62)					24 grains.
Bromide of ammonium	-	-	-	-	16 “

This collodion should be allowed to stand and settle twenty-four hours before it is used: when wanted, it should be poured off into a collodion vial. The more free the collodion is from sediment and small particles of dust or undissolved cotton, the softer and more perfect will be the impression it makes.

In case the above proportions of iodide of potassium should not produce a cream-colored coating, when it comes from the nitrate of silver bath, more may be added: for example, if the coating is of a bluish tint, I would dissolve 6 grains of iodide of potassium in water, as before, and then try it: shake well, and test it by putting a little on a slip of glass, and dipping it into the silvering solution; if it coats to a cream-color, it is right.

It should be borne in mind, that after the addition of iodide of potassium here recommended, the collodion should be allowed to stand until settled, before undertaking to produce a picture, although the coating may be previously tested by means of a slip of glass.

SOLUTION OF BROMIDE AND IODIDE OF POTASSIUM AND SILVER.

Dissolve 130 grains of crystallized nitrate of silver in 4 ounces of pure water, in a long 8-ounce vial. Then in a clean 1-ounce graduate, or some other convenient vessel

containing half an ounce of water, dissolve 130 grains bromide of potassium. When this and the nitrate of silver are both dissolved, pour the solution of bromide of potassium into the vial containing the silver, and a thick yellow precipitate will fall. This is the bromide of potassium and silver. This should be washed by nearly filling the vial with water; shake it, and then let it settle, which it will readily do, and then pour on the water, leaving the yellow mass in the bottom of the vial; continue this operation of washing for at least ten changes of water; then, after draining off the water as close as possible, put into the vial four ounces of alcohol, shake it well and let it settle; then pour off as close as possible. By this means the water is nearly all taken out.

Pour into the vial *three* ounces of alcohol; then in a small mortar finely pulverize one ounce of iodide of silver, and the solution, which was before clear, will be more or less of a yellow color, and the bulk of the yellow precipitate will be diminished. I have sometimes completely re-dissolved the yellow precipitate, but this does not often occur, except there be more water present than is advisable. It is better to have an excess of bromide of potassium in the solution. This can be seen by its being white, and remaining undissolved in the bottom of the vial. This solution should be prepared in the evening, or in a dark room, and only the light of a lamp or candle employed.

DOUBLE IODIDE OF POTASSIUM AND SILVER.

This solution is made in the same manner as in the foregoing article, substituting the iodide of potassium for the bromide—no bromide being used in this preparation.

The yellow precipitate in this case will be re-dissolved and taken up in the solution: it may require more than one ounce of pulverized iodide of potassium to effect this, but it may be added in excess, so that the solution shall contain a quantity in powder.

DEVELOPING SOLUTION

Proto-sulphate of iron,	-	-	3 ounces.
Rain or distilled water,	-	-	1 quart.

Put these into a quart bottle, and shake until the crystals are all dissolved, and this can be kept for a stock bottle, and when wanted for use pour into another bottle.

Of the above solution,	-	-	5 ounces.
Acetic acid (No. 8)	-	-	1 "
Chemically pure nitric acid	-	-	20 drops.

Shake this mixture well, and filter through a sponge, and it is ready for use. I file a mark in this bottle indicating five ounces, and another for 1 ounce: this will save time in mixing the solution.

Remarks.—In my recent tour of the United States, I found it difficult to obtain a good article of proto-sulphate of iron, and in its stead I used the common copperas, such as I could find almost in any store. I employ from one-fourth to one-half more than the quantity given above. If it looked a clear green, and free from a white or brownish powder, about one-fourth addition: *i. e.*, four ounces, instead of three, as given above. If the solution in the stock bottle is not wanted for a week or more, a few crystals of the proto-sulphate of iron should be added, as it decomposes, and the strength is depreciated.

There is quite a difference in the strength of the acetic acid as sold by our country druggists, and the operator should be sure that he has No. 8, to which quality the above proportions are adapted. I never have employed the developing solution but once, but can see no objections to use it for a number of glass plates, but it should be filtered every time before using. The quantity of nitric acid may be increased, so long as a proper proportion is preserved with the strength of the bath. The effect of this addition of acid will be to brighten the impression; but if carried too far, the reduction (developing) will be irregular, and the harmony of the impression injured.

FIXING SOLUTION.

Water,	-	-	-	-	-	8 ounces.
Cyanide of potassium,	-	-	-	-	-	about 1 drachm.

Remarks.—I put enough of the cyanide of potassium into the water to make the solution of such strength as to dissolve off the iodide of silver ("coating") in from twenty to sixty seconds. The operation is quite similar to that of hyposulphate of soda upon the coating of the Daguerreotype plate. A too concentrated solution is likely to injure the sharpness of the image.

BRIGHTENING AND FINISHING THE IMAGE.

The article I now employ for finishing off my Positives is in market, and known as HUMPHREY'S COLLODION GILDING. It is a new preparation, and exerts a powerful influence upon the image, having the same brightening effect as chloride of gold on the daguerreotype. There is no ar-

ticle now in market that equals this. I have until quite recently used a varnish for this purpose, but having something that is of far greater value, I have discarded it. It is one of the most valuable improvements since the application of the Collodion Film as a vehicle for producing photographic images. It is a new discovery, and is being rapidly brought into use by the first ambrotypers and photographers in America. It adds at least one-half to the beauty of an ambrotype, above any method heretofore in use. It is *imperishable*, giving a surface almost equal in hardness to the glass itself. It is easy of application; it gives a brilliant finish; it is not affected by a moist atmosphere; it is not affected by pure water; it is the best article ever used for *finishing ambrotypes*; it will preserve glass negatives for all time; it will preserve the *whites* in the ambrotype; it gives a rich lustre to drapery; it will bear exposure to the hot sun; it preserves positives and negatives from injury by light. It is an article that, when once tried, the operator upon glass (positive, negative, or albumenized plates) *will not do without*.

The ingredients in the composition of this gilding are neither *patented* nor *published*, but it can be procured from any dealer in photographic chemicals.

NITRATE OF SILVER BATH.

I here give what I consider an improvement on the bath mentioned in the first edition of this work. I first published it in *Humphrey's Journal*, No. 23, Vol. VII.:

The nitrate of silver solution is an important mixture in the chemical department of the ambrotype process, and

requires the especial care of the operator in its preparation. I give the following as one of the most approved for general practice. It is well adapted to the production of positives, and its action is of great uniformity.

Pure water	-	-	-	-	-	1 ounce.
Nitrate of silver in crystals [neutral to acid test]						45 grains.
Nitric acid C. P. [Quantity as given below].						

This proportion is to be observed for any quantity of solution. If I were to prepare a bath 40 ounces, I would proceed as follows :

Water	-	-	-	-	-	40 ounces.
Nitrate of silver	-	-	-	-	-	1800 grains.

Measure the water, and put into a two-quart bottle ; then pour out 8 oz. of it in a pint bottle, and into this put the whole of the nitrate of silver (1800 gr.) ; shake it well until it is all dissolved. This forms a concentrated solution—into which put the following prepared iodide of silver :—

Dissolve in a 3 or 4 oz. bottle containing 1 oz. water, 10 gr. nitrate of silver ; and in another bottle or graduate containing a little water, dissolve 10 grains of iodide of potassium ; pour this into the 10 grain solution of nitrate of silver, and a yellow substance (iodide of silver) will precipitate ; fill the bottle with water, and let it settle ; then pour off the water, leaving the yellow mass behind ; again pour on it clean water, shake it, and let it settle as before, and pour off again ; repeat this for about six changes of water.

Then it (the iodide of silver) is to be put into the bottle containing the 8 oz. water and 1800 gr. of nitrate of silver; shake it well, and it will nearly or quite all dissolve; pour this into the two-quart bottle, and shake well; it will be of a yellowish white tint, and should be filtered through asbestos or sponge, when it will become clear. When clear, test the solution with blue litmus-paper; if it turns it red, it is sufficiently acid; if it does not change it, add *one* or *two* drops of nitric acid, chemically pure; then test it again; if it does not change it, add *one* or *two* drops more, or just enough to change the paper to the slightest red.

A solution prepared in this proportion will, like others, improve by age. An old bath is considered far more valuable than one newly prepared. These remarks may appear to old photographic operators as of no importance, but they must bear in mind that there are hundreds just adopting this new process of picture taking.

This solution will work more satisfactorily than the one I formerly used. It will work quicker in the camera, and is *equally* durable.

ACKNOWLEDGMENT.—The following pages, under the head of *Vocabulary of Photographic Chemicals*, and treating upon the Chemicals used in Photography, are taken from the third edition of “Hardwich’s Photographic Chemistry:”—

Vocabulary of Photographic Chemicals.

ACETIC ACID.

Symbol, $C_4H_3O_3 + HO$. Atomic weight, 60.

Acetic acid is a product of the *oxidation* of alcohol.

Spirituous liquids, when perfectly pure, are not affected by exposure to air; but if a portion of yeast, or nitrogenous organic matter of any kind, be added, it soon acts as a *ferment*, and causes the spirit to unite with oxygen derived from the atmosphere, and to become *sour* from formation of acetic acid or "vinegar."

Acetic acid is also produced on a large scale by heating *wood* in close vessels; a substance distils over which is acetic acid contaminated with empyreumatic and tarry matter; it is termed pyroligneous acid, and is much used in commerce.

The most concentrated acetic acid may be obtained by neutralizing common vinegar with carbonate of soda and crystallizing out the acetate of soda so formed; this acetate of soda is then distilled with sulphuric acid, which removes the soda and liberates acetic acid: the acetic acid being volatile, distils over, and may be condensed.

Properties of Acetic Acid.—The strongest acid contains only a single atom of water; it is sold under the name of "glacial acetic acid," so called from its property of solidifying at a moderately low temperature. At about 50° the crystals melt, and form a limpid liquid of pungent odor and a density nearly corresponding to that of water; the specific gravity of acetic acid, however, is no test of its real strength, which can only be estimated by analysis.

The commercial glacial acetic acid is often diluted with water, which may be suspected if it does not solidify during the cold winter months. Sulphurous and hydrochloric acids are also common impurities. They are injurious in photographic processes from their property of precipitating nitrate of silver. To detect them proceed as follows:—dissolve a small crystal of nitrate of silver in a

few drops of water, and add to it about half a drachm of the glacial acid; the mixture should remain quite clear even when exposed to the light. Hydrochloric and sulphurous acids produce a white deposit of chloride or sulphite of silver; and if *aldehyde* or volatile tarry matter be present in the acetic acid, the mixture with nitrate of silver, although clear at first, becomes discolored by the action of light.

Many photographers employ a cheaper form of acetic acid, sold by druggists as "Beaufoy's" acid;* it should be of the strength of the acetic acid fortiss. of the London Pharmacopœia, containing 30 per cent. real acid, and must be tested for sulphuric acid (see sulphuric acid), and also by mixing with nitrate of silver.

ACETATE OF SILVER. (See Silver, Acetate of.)

ALBUMEN.

Albumen is an organic principle, found both in the animal and vegetable kingdom. Its properties are best studied in the *white of egg*, which is a very pure form of albumen.

Albumen is capable of existing in two states; in one of which it is soluble, in the other insoluble in water. The aqueous solution of the soluble variety gives a slightly alkaline reaction to test-paper; it is somewhat thick and glutinous, but becomes more fluid on the addition of a small quantity of an alkali, such as potash or ammonia.

* In this country the practitioner uses the article sold in market as "Acetic Acid, No. 8."—S. D. H.

Soluble albumen may be converted into the *insoluble* form in the following ways :—

1. *By the application of heat.*—A moderately strong solution of albumen becomes opalescent and coagulates on being heated to about 150° , but a temperature of 212° is required if the liquid is very dilute. A layer of *dried* albumen cannot easily be coagulated by the mere application of heat.

2. *By addition of strong acids.*—Nitric acid coagulates albumen perfectly without the aid of heat. Acetic acid, however, acts differently, appearing to enter into combination with the albumen, and forming a compound soluble in warm water acidified by acetic acid.

3. *By the action of metallic salts.*—Many of the salts of the metals coagulate albumen very completely. Nitrate of silver does so; also the bichloride of mercury. Ammoniacal oxide of silver, however, does not coagulate albumen.

The white precipitate formed on mixing albumen with nitrate of silver is a chemical compound of the animal matter with protoxide of silver. This substance, which has been termed albuminate of silver, is soluble in ammonia and hyposulphite of soda; but after exposure to light, or heating in a current of hydrogen gas, it assumes a brick-red color, being probably reduced to the condition of a salt of the *suboxide* of silver. It is then almost insoluble in ammonia, but enough dissolves to tinge the liquid wine-red. The author is of opinion that the *red coloration* of solution of nitrate of silver employed in sensitizing the albumenized photographic paper is produced by the same compound, although often referred to the presence of sulphuret of silver.

Albumen also combines with lime and baryta; and chloride of barium has been recommended in positive printing upon albumenized paper, probably from this cause.

Chemical composition of albumen.—Albumen belongs to the *nitrogenous* class of organic substances. It also contains small quantities of sulphur and phosphorus.

ALCOHOL.

Symbol, $C_4H_6O_2$. Atomic weight, 46.

Alcohol is obtained by the careful distillation of any spirituous or fermented liquor. If wine or beer be placed in a retort, and heat applied, the alcohol, being more volatile than water, rises first, and is condensed in an appropriate receiver; a portion of the vapor of water, however, passes over with the alcohol, and dilutes it to a certain extent, forming what is termed "spirits of wine." Much of this water may be removed by redistillation from carbonate of potash; but in order to render the alcohol thoroughly *anhydrous*, it is necessary to employ *quick lime*, which possesses a still greater attraction for water. An equal weight of this powdered lime is mixed with strong alcohol of $\cdot 823$, and the two are distilled together.

Properties of Alcohol.—Pure anhydrous alcohol is a limpid liquid, of an agreeable odor and pungent taste; sp. gr. at 60° , $\cdot 794$. It absorbs vapor of water, and becomes diluted by exposure to damp air; boils at 173° Fahr. It has never been frozen.

Alcohol distilled from carbonate of potash has a specific gravity of $\cdot 815$ to $\cdot 823$, and contains 90 to 93 per cent. of real spirit.

The specific gravity of ordinary rectified spirits of wine is usually about $\cdot 840$, and it contains 80 to 83 per cent. of absolute alcohol.

AMMONIA.

Symbol, NH_3 or NH_4O . Atomic weight, 17.

The liquid known by this name is an aqueous solution of the volatile gas ammonia. Ammoniacal gas contains 1 atom of nitrogen combined with three of hydrogen: these two elementary bodies exhibit no affinity for each other, but they can be made to unite under certain circumstances, and the result is ammonia.

Properties of Ammonia.—Ammoniacal gas is soluble in water to a large extent; the solution possessing those properties which are termed alkaline. Ammonia, however, differs from the other alkalis in one important particular—it is volatile: hence the original color of turmeric paper affected by ammonia is restored on the application of heat. Solution of ammonia absorbs carbonic acid rapidly from the air, and is converted into carbonate of ammonia; it should therefore be preserved in stoppered bottles. Besides carbonate, commercial ammonia often contains chloride of ammonium, recognized by the white precipitate given by nitrate of silver after acidifying with pure nitric acid.

The strength of commercial ammonia varies greatly; that sold for pharmaceutica purposes, under the name of liquor ammoniæ, contains about 10 per cent. of real ammonia. The sp. gr. of aqueous ammonia *diminishes* with the proportion of ammonia present, the liquor ammoniæ being usually about $\cdot 936$.

Chemical Properties.—Ammonia, although forming a large class of salts, appears at first sight to contrast strongly in composition with the alkalies proper, such as potash and soda. Mineral bases generally are *protoxides of metals*, but ammonia consists simply of nitrogen and hydrogen united with oxygen. The following remarks may perhaps tend somewhat to elucidate the difficulty:—

Theory of Ammonium.—This theory supposes that a substance exists possessing the properties of a *metal*, but different from metallic bodies generally in being *compound* in structure: the formula assigned to it is NH_4 , 1 atom of nitrogen united with 4 of hydrogen. The hypothetical metal is termed “ammonium,” and ammonia, associated with an atom of water, may be viewed as its *oxide*; for $\text{NH}_3 + \text{HO}$ plainly equals NH_4O . Thus, as potash is the oxide of *potassium*, so ammonia is the oxide of *ammonium*.

The composition of the *salts* of ammonia is on this view assimilated to those of the alkalies proper. Thus, sulphate of ammonia is a sulphate of the oxide of ammonium; muriate or hydrochlorate of ammonia is a chloride of ammonium, etc.

AMMONIO-NITRATE OF SILVER.

(See Silver, Ammonio-Nitrate of.)

AQUA REGIA. (See Nitro-Hydrochloric Acid.)

BARYTA, NITRATE OF. (See Nitrate of Baryta.)

BICHLORIDE OF MERCURY.

(See Mercury, Bichloride of.)

BROMINE.

Symbol, Br. Atomic weight, 78.

This elementary substance is obtained from the uncrys-

tallizable residuum of sea-water, termed *bittern*. It exists in the water in very minute proportion, combined with magnesium in the form of a soluble bromide of magnesium.

Properties.—Bromine is a deep reddish-brown liquid of a disagreeable odor, and fuming strongly at common temperatures; sparingly soluble in water (1 part in 23, Lowig), but more abundantly so in alcohol, and especially in ether. It is very heavy, having a specific gravity of 3.0.

Bromine is closely analogous to chlorine and iodine in its chemical properties. It stands on the list intermediately between the two; its affinities being stronger than those of iodine, but weaker than chlorine. (See chlorine.)

It forms a large class of salts, of which the bromides of potassium, cadmium, and silver are the most familiar to photographers.

BROMIDE OF POTASSIUM.

Symbol, KBr. Atomic weight, 118.

Bromide of potassium is prepared by adding bromine to caustic potash, and heating the product, which is a mixture of bromide of potassium and bromate of potash, to redness, in order to drive off the oxygen from the latter salt. It crystallizes in anhydrous cubes, like the chloride, and iodide, of potassium; it is easily soluble in water, but more sparingly so in alcohol; it yields red fumes of bromine when acted upon by sulphuric acid.

BROMIDE OF SILVER. (*See Silver, Bromide of.*)

CARBONATE OF SODA.

Symbol, $\text{NaO CO}_2 + 10 \text{ Aq.}$

This salt was formerly obtained from the ashes of sea-

weeds, but is now more economically manufactured on a large scale from common salt. The chloride of sodium is first converted into sulphate of soda, and afterwards the sulphate into carbonate of soda.

Properties.—The perfect crystals contain ten atoms of water, which are driven off by the application of heat, leaving a white powder—the anhydrous carbonate. *Common washing soda* is a neutral carbonate, contaminated to a certain extent with chloride of sodium and sulphate of soda. The carbonate used for effervescing draughts is either a bicarbonate with 1 atom of water, or a sesquicarbonate, containing about 40 per cent. of real alkali; it is therefore nearly double as strong as the washing carbonate, which contains about 22 per cent. of soda. Carbonate of soda is soluble in twice its weight of water at 60°, the solution being strongly alkaline.

CARBONATE OF POTASH. (*See* Potash, Carbonate of.)

CASEINE. (*See* Milk.)

CHARCOAL, ANIMAL.

Animal charcoal is obtained by heating animal substances, such as bones, dried blood, horns, etc., to redness, in close vessels, until all volatile empyreumatic matters have been driven off, and a residue of carbon remains. When prepared from bones it contains a large quantity of inorganic matter in the shape of carbonate and phosphate of lime, the former of which produces *alkalinity* in reacting upon nitrate of silver. Animal charcoal is freed from these earthy salts by repeated digestion in hydrochloric acid; but unless very carefully washed it is apt to retain

an acid reaction, and so to liberate free nitric acid when added to solution of nitrate of silver.

Properties.—Animal charcoal, when pure, consists solely of carbon, and burns away in the air without leaving any residue: it is remarkable for its property of decolorizing solutions; the organic coloring substance being separated, but not actually *destroyed*, as it is by *chlorine* employed as a bleaching agent. This power of absorbing coloring matter is not possessed in an equal degree by all varieties of charcoal, but is in great measure peculiar to those derived from the animal kingdom.

CHINA CLAY OR KAOLIN.

This is prepared, by careful levigation, from mouldering granite and other disintegrated felspathic rocks. It consists of the *silicate of alumina*,—that is, of silicic acid or *flint*, which is an oxide of silicon, united with the base alumina (oxide of aluminum). Kaolin is perfectly insoluble in water and acids, and produces no decomposition in solution of nitrate of silver. It is employed by photographers to decolorize solutions of nitrate of silver which have become brown from the action of albumen or other organic matters.

CHLORINE.

Symbol, Cl. Atomic weight, 36.

Chlorine is a chemical element found abundantly in nature, combined with metallic sodium in the form of chloride of sodium, or sea-salt.

Preparation—By distilling common salt with sulphuric acid, sulphate of soda and hydrochloric acid are formed.

Hydrochloric acid contains chlorine combined with hydrogen ; by the action of *nascent* oxygen (see oxygen), the hydrogen may be removed in the form of water, and the chlorine left alone.

Properties.—Chlorine is a greenish-yellow gas, of a pungent and suffocating odor ; soluble to a considerable extent in water, the solution possessing the odor and color of the gas. It is nearly $2\frac{1}{2}$ times as heavy as a corresponding bulk of atmospheric air.

Chemical Properties.—Chlorine belongs to a small natural group of elements which contains also bromine, iodine, and fluorine. They are characterized by having a strong affinity for hydrogen, and also for the metals, but are comparatively indifferent to oxygen. Many metallic substances actually undergo *combustion* when projected into an atmosphere of chlorine, the union between the two taking place with extreme violence. The characteristic bleaching properties of chlorine gas are explained in the same manner :—Hydrogen is removed from the organic substance, and in that way the structure is broken up and the color destroyed.

Chlorine is more powerful in its affinities than either bromine or iodine. The salts formed by these three elements are closely analogous in composition and often in properties. Those of the alkalis, alkaline earths, and many of the metals are soluble in water, but the silver salts are insoluble ; the lead salts sparingly so.

The combinations of chlorine, bromine, iodine, and fluorine, with hydrogen, are acids, and neutralize alkalis in the usual manner, with formation of alkaline chloride and water.

The test by which the presence of chlorine is detected,

either free or in combination with bases, is *nitrate of silver*; it gives a white curdy precipitate of chloride of silver, insoluble in nitric acid, but soluble in ammonia. The solution of nitrate of silver employed as the test must not contain iodide of silver, as this compound is precipitated by dilution.

CHLORIDE OF AMMONIUM.

Symbol, $\text{NH}_4 \text{Cl}$. Atomic weight, 54.

This salt, also known as muriate or hydrochlorate of ammonia, occurs in commerce in the form of colorless and translucent masses, which are procured by *sublimation*, the dry salt being volatile when strongly heated. It dissolves in an equal weight of boiling, or in three parts of cold water. It contains more *chlorine* in proportion to the weight used than chloride of sodium, the atomic weights of the two being as 54 to 60.

CHLORIDE OF BARIUM.

Symbol, $\text{BaCl} + 2 \text{HO}$. Atomic weight, 123.

Barium is a metallic element, very closely allied to calcium, the elementary basis of *lime*. The chloride of barium is commonly employed as a test for sulphuric acid, with which it forms an insoluble precipitate of sulphate of baryta. It is also said to affect the color of the photographic image when used in preparing positive paper; which may possibly be due to a chemical combination of baryta with albumen: but it must be remembered that this chloride, from its high atomic weight, contains *less* chlorine than the alkaline chlorides.

Properties of Chloride of Barium.—Chloride of barium

occurs in the form of white crystals, soluble in about two parts of water, at common temperature. These crystals contain two atoms of water of crystallization, which are expelled at 212° , leaving the anhydrous chloride.

CHLORIDE OF GOLD. (*See* Gold, Chloride of.)

CHLORIDE OF SODIUM.

Symbol, NaCl. Atomic weight, 60.

Common salt exists abundantly in nature, both in the form of solid rock-salt and dissolved in the waters of the ocean.

Properties of the pure Salt.—Fusible without decomposition at low redness, but sublimes at higher temperatures; the melted salt concretes into a hard white mass on cooling. Nearly insoluble in absolute alcohol, but dissolves in minute quantity in rectified spirit. Soluble in three parts of water, both hot and cold. Crystallizes in cubes, which are anhydrous.

Impurities of Common Salt.—Table salt often contains large quantities of the chlorides of magnesium and calcium, which, being deliquescent, produce a dampness by absorption of atmospheric moisture: sulphate of soda is also commonly present. The salt may be purified by repeated recrystallization, but it is more simple to prepare the pure compound *directly*, by neutralizing hydrochloric acid with carbonate of soda.

CHLORIDE OF SILVER. (*See* Silver, Chloride of.)

CITRIC ACID.

This acid is found abundantly in lemon-juice and in

lime-juice. It occurs in commerce in the form of large crystals, which are soluble in less than their own weight of water at 60° .

Commercial citric acid is sometimes mixed with tartaric acid. The adulteration may be discovered by making a concentrated solution of the acid and adding *acetate of potash*; crystals of bitartrate of potash will separate if tartaric acid be present.

Citric acid is tribasic. It forms with silver a white insoluble salt, containing 3 atoms of oxide of silver to 1 atom of citric acid. If the citrate of silver be heated in a current of hydrogen gas, a part of the acid is liberated and the salt is reduced to a citrate of *suboxide* of silver; which is of a red color. The action of white light in red-denning citrate of silver is shown by the author to be of a similar nature.

CYANIDE OF POTASSIUM.

Symbol, K, C_2N , or KCy. Atomic weight, 66.

This salt is a compound of cyanogen gas with the metal potassium. Cyanogen is not an elementary body, like chlorine or iodine, but consists of carbon and nitrogen united in a peculiar manner. Although a compound substance, it reacts in the manner of an element, and is therefore (like *ammonium*, previously described) an exception to the usual laws of chemistry. Many other bodies of a similar character are known.

ETHER.

Symbol, C_4H_5O . Atomic weight, 37.

Ether is obtained by distilling a mixture of sulphuric

acid and alcohol. If the formula of alcohol ($C_4H_6O_2$) be compared with that of ether, it will be seen to differ from it in the possession of an additional atom of hydrogen and of oxygen: in the reaction, the sulphuric acid removes these elements in the form of water, and by so doing converts one atom of alcohol into an atom of ether. The term *sulphuric* applied to the commercial ether has reference only to the manner of its formation.

Properties of Ether.—It is neither acid nor alkaline to test-paper. Specific gravity, at 60° , about $\cdot 720$. Boils at 98° Fahrenheit. The vapor is exceedingly dense, and may be seen passing off from the liquid and falling to the ground: hence the danger of pouring ether from one bottle to another if a flame be near at hand.

Ether does not mix with water in all proportions; if the two are shaken together, after a short time the former rises and floats upon the surface. In this way a mixture of ether and alcohol may be purified to some extent, as in the common process of *washing* ether. The water employed however always retains a certain portion of ether (about a tenth part of its bulk), and acquires a strong ethereal odor; washed ether also contains water in small quantity.

Bromine and iodine are both soluble in ether, and gradually react upon and decompose it.

The strong alkalies, such as potash and soda, also decompose ether slightly after a time, but not immediately. Exposed to air and light, ether is oxidized and acquires a peculiar odor.

Ether dissolves fatty and resinous substances readily, but inorganic salts are mostly insoluble in this fluid. Hence it is that iodide of potassium and other substances

dissolved in alcohol are precipitated to a certain extent by the addition of ether.

FLUORIDE OF POTASSIUM.

Symbol, KF. Atomic weight, 59.

Preparation.—Fluoride of potassium is formed by saturating hydrofluoric acid with potash, and evaporating to dryness in a platinum vessel. *Hydrofluoric acid* contains fluorine combined with hydrogen; it is a powerfully acid and corrosive liquid, formed by decomposing fluor spar, which is a *fluoride of calcium*, with strong sulphuric acid; the action which takes place being precisely analogous to that involved in the preparation of hydrochloric acid.

Properties.—A deliquescent salt, occurring in small and imperfect crystals. Very soluble in water: the solution acting upon glass in the same manner as hydrofluoric acid.

FORMIC ACID.

Symbol, C_2HO_3 . Atomic weight, 37.

This substance was originally discovered in the *red ant* (*Formica rufa*), but it is prepared on a large scale by distilling *starch* with binoxide of manganese and sulphuric acid.

Properties.—The strength of commercial formic acid is uncertain, but it is always more or less dilute. The strongest acid, as obtained by distilling formiate of soda with sulphuric acid, is a fuming liquid with a pungent odor, and containing only one atom of water: it inflames the skin in the same manner as the sting of the ant.

Formic acid reduces the oxides of gold, silver, and mer-

cury, to the metallic state, and is itself oxidized into carbonic acid. The alkaline formiates also possess the same properties.

GELATINE.

Symbol, $C_{13}H_{10}O_5N_2$. Atomic weight, 156.

This is an organic substance somewhat analogous to albumen, but differing from it in properties. It is obtained by subjecting bones, hoofs, horns, calves' feet, etc., to the action of boiling water. The jelly formed on cooling is termed *size*, or when dried or cut into slices, *glue*. Gelatine, as it is sold in the shops, is a pure form of glue. *Isinglass* is gelatine prepared, chiefly in Russia, from the air-bladders of certain species of sturgeon.

Properties of Gelatine.—Gelatine softens and swells up in cold water, but does not *dissolve* until heated: the hot solution, on cooling, forms a tremulous jelly. One ounce of cold water will retain about three grains of isinglass without gelatinizing; but much depends upon the temperature, a few degrees greatly affecting the result.

Gelatine forms no compound with oxide of silver analogous to the albuminate of silver; which fact explains the difference in the photographic properties of albumen and gelatine.

GLYCERINE.

Fatty bodies are resolved by treatment with an alkali into an acid—which combines with the alkali, forming a *soap*,—and glycerine, remaining in solution.

Pure glycerine, as obtained by Price's patent process of distillation, is a viscid liquid of sp. gr. about 1.23; miscible in all proportions with water and alcohol. It is peculiarly a neutral substance, exhibiting no tendency to combine

with acids or bases. It has little or no action upon nitrate of silver in the dark, and reduces it very slowly even when exposed to light.

GOLD, CHLORIDE OF.

Symbol, AuCl_3 . Atomic weight, 303.

This salt is formed by dissolving pure metallic gold in nitro-hydrochloric acid, and evaporating at a gentle heat. The solution affords deliquescent crystals of a deep orange color.

Chloride of gold, in a state fit for photographic use may easily be obtained by the following process:—Place a half-sovereign in any convenient vessel, and pour on it half a drachm of nitric acid mixed with two and a half drachms of hydrochloric acid and three drachms of water; digest by a gentle heat, but do not *boil* the acid, or much of the chlorine will be driven off in the form of gas. At the expiration of a few hours add fresh aqua regia in quantity the same as at first, which will probably complete the solution, but if not, repeat the process a third time.

Lastly, neutralize the liquid by adding carbonate of soda until all effervescence ceases, and a green precipitate forms; this is *carbonate of copper*, which must be allowed several hours to separate thoroughly. The solution then contains chloride of gold in a neutral state, and free from copper and silver, with which the metallic gold is alloyed in the standard coin of the realm.

The weight of a half-sovereign is about 61 grains, of which 56 grains are pure gold. This is equivalent to 86 grains of chloride of gold, which will therefore be the quantity contained in the solution.

The following process for preparing chloride of gold is more perfect than the last:—dissolve the gold coin in aqua regia as before; then boil with excess of hydrochloric acid to destroy the nitric acid, dilute largely with distilled water, and add a filtered aqueous solution of common sulphate of iron (6 parts in 1 part of gold); collect the precipitated gold, which is now free from copper; re-dissolve in aqua regia, and evaporate to dryness on a water bath.

Avoid using ammonia to neutralize chloride of gold, as it would be liable to occasion a deposit of “fulminating gold,” the properties of which are described immediately following.

Properties of Chloride of Gold.—As sold in commerce it usually contains excess of hydrochloric acid, and is then of a bright yellow color; but when neutral and somewhat concentrated it is dark red (*Leo ruber* of the alchemists). It gives no precipitate with carbonate of soda, unless heat be applied; the free hydrochloric acid present forms, with the alkali, chloride of sodium, which unites with the chloride of gold, and produces a double salt, chloride of gold and sodium, soluble in water.

Chloride of gold is decomposed with precipitation of metallic gold by charcoal, sulphurous acid, and many of the vegetable acids; also by protosulphate and protonitrate of iron. It tinges the cuticle of an indelible purple tint. It is soluble in alcohol and in ether.

GOLD, FULMINATING.

This is a yellowish-brown substance, precipitated on adding ammonia to a strong solution of chloride of gold.

It may be dried carefully at 212° , but *explodes violently* on being heated suddenly about to 290° . Friction also causes it to explode when dry ; but the moist powder may be rubbed or handled without danger. It is decomposed by sulphuretted hydrogen.

Fulminating gold is probably an aurate of ammonia, containing 2 atoms of ammonia to 1 atom of peroxide of gold.

GOLD, HYPOSULPHITE OF.

Symbol, $\text{AuO S}_2\text{O}_2$. Atomic weight, 253.

Hyposulphite of gold is produced by the reaction of chloride of gold upon hyposulphite of soda.

The salt sold in commerce as sel d'or is a double hyposulphite of gold and soda, containing one atom of the former salt to three of the latter, with four atoms of water of crystallization. It is formed by adding one part of chloride of gold, in solution, to three parts of hyposulphite of soda, and precipitating the resulting salt by alcohol ; the chloride of gold must be added to the hyposulphite of soda, and not the soda salt to the gold.

Properties.—Hyposulphite of gold is unstable and cannot exist in an isolated state, quickly passing into sulphur, sulphuric acid, and metallic gold. When combined with excess of hyposulphite of soda in the form of sel d'or, it is more permanent.

Sel d'or occurs crystallized in fine needles, which are very soluble in water. The commercial article is often impure, containing little else than hyposulphite of soda, with a trace of gold. It may be analyzed by adding a few drops of strong nitric acid (free from chlorine) diluting

with water, and afterwards collecting and igniting the yellow powder, which is metallic gold.

GRAPE SUGAR.

Symbol, $C_{24}H_{28}O_{28}$. Atomic weight, 396.

This modification of sugar, often termed *granular sugar*, or *glucose*, exists abundantly in the juice of grapes, and in many other varieties of fruit. It forms the saccharine concretion found in honey, raisins, dried figs, etc. It may be produced artificially by the action of fermenting principles, and of dilute mineral acids, upon starch.

Properties.—Grape sugar crystallizes slowly and with difficulty from a concentrated aqueous solution, in small hemispherical nodules, which are hard, and feel gritty between the teeth. It is much less sweet to the taste than cane sugar, and not so soluble in water (1 part dissolves in $1\frac{1}{2}$ of cold water). Grape sugar tends to absorb oxygen, and hence it possesses the property of decomposing the salts of the noble metals, and reducing them by degrees to the metallic state, even without the aid of light. The action however in the case of *nitrate of silver* is slow, unless the temperature be somewhat elevated. *Cane sugar* does not possess these properties to an equal extent, and hence it is readily distinguished from the other variety.

HONEY.

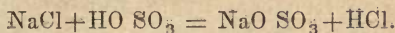
This substance contains two distinct kinds of sugar, grape sugar, and an uncrystallizable substance analogous to, or identical with, the treacle found associated with common sugar in the cane juice. The agreeable taste of honey probably depends upon the latter, but its reducing

power on metallic oxides is due to the former. Pure grape sugar can readily be obtained from inspissated honey, by treating it with alcohol, which dissolves out the syrup, but leaves the crystalline portion.

HYDROCHLORIC ACID.

Symbol, HCl. Atomic weight, 37.

Hydrochloric acid is a volatile gas, which may be liberated from the salts termed chlorides by the action of sulphuric acid. The acid, by its superior affinities, removes the base; thus,—



Properties.—Abundantly soluble in water, forming the liquid hydrochloric or muriatic acid of commerce. The most concentrated solution of hydrochloric acid has a sp. gr. 1.2, and contains about 40 per cent. of gas; that commonly sold is somewhat weaker, sp. gr. 1.14=28 per cent. real acid.

Pure hydrochloric acid is colorless, and fumes in the air. The yellow color of the commercial acid depends upon the presence of traces of perchloride of iron or organic matter; commercial muriatic acid also often contains a portion of free chlorine and of sulphuric acid.

HYDRIODIC ACID.

Symbol, HI. Atomic weight, 127.

This is a gaseous compound of hydrogen and iodine, corresponding in composition to the hydrochloric acid. It cannot, however, from its instability, be obtained in the same manner, since, on distilling an iodide with sulphuric

acid, the hydriodic acid first formed is subsequently decomposed into iodine and hydrogen. An aqueous solution of hydriodic acid is easily prepared by adding iodine to water containing sulphuretted hydrogen gas; a decomposition takes place, and sulphur is set free; thus: $HS + I = HI + S$.

Properties.—Hydriodic acid is very soluble in water, yielding a strongly acid liquid. The solution, colorless at first, soon becomes brown from decomposition, and liberation of free iodine. It may be restored to its original condition by adding solution of sulphuretted hydrogen.

HYDROSULPHURIC ACID.

Symbol, HS. Atomic weight, 17.

This substance, also known as sulphuretted hydrogen, is a gaseous compound of sulphur and hydrogen, analogous in composition to hydrochloric and hydriodic acids. It is usually prepared by the action of dilute sulphuric acid upon sulphuret of iron, the decomposition being similar to that involved in the preparation of the hydrogen acids generally:—



Properties.—Cold water absorbs three times its bulk of hydrosulphuric acid, and acquires the peculiar putrid odor and poisonous qualities of the gas. The solution is faintly acid to test-paper, and becomes opalescent on keeping, from gradual separation of sulphur. It is decomposed by nitric acid, and also by chlorine and iodine. It precipitates silver from its solutions, in the form of black sulphuret of silver; also copper, mercury, lead, etc.; but iron and other metals of that class are not affected, if the

liquid contains free acid. Hydrosulphuric acid is constantly employed in the chemical laboratory for these and other purposes.

HYDROSULPHATE OF AMMONIA.

Symbol, $\text{NH}_4\text{S HS}$. Atomic weight, 51.

The liquid known by this name, and formed by passing sulphuretted hydrogen gas into ammonia, is a double sulphuret of hydrogen and ammonium. In the preparation, the passage of the gas is to be continued until the solution gives no precipitate with sulphate of magnesia and smells strongly of hydrosulphuric acid.

Properties.—Colorless at first, but afterwards changes to yellow, from liberation and subsequent solution of sulphur. Becomes milky on the addition of any acid. Precipitates, in the form of sulphuret, all the metals which are affected by sulphuretted hydrogen; and, in addition, those of the class to which iron, zinc, and manganese, belong.

Hydrosulphate of ammonia is employed in photography to darken the negative image, and also in the preparation of iodide of ammonium; the separation of silver from hyposulphite solutions, etc.

HYPOSULPHITE OF SODA.

Symbol, $\text{NaO S}_2\text{O}_2 + 5 \text{HO}$. Atomic weight, 125.

The hyposulphite of soda commonly employed by photographers is a neutral combination of hyposulphurous acid and the alkali soda. It is selected as being more

economical in preparation than any other hyposulphite adapted for fixing.

Hyposulphite of soda occurs in the form of large translucent groups of crystals, which include five atoms of water. These crystals are soluble in water almost to any extent, the solution being attended with the production of cold; they have a nauseous and bitter taste.

HYPOSULPHITE OF GOLD.

(See Gold, Hyposulphite of.)

HYPOSULPHITE OF SILVER. (See Silver, Hyposulphite of.)

ICELAND MOSS.

Cetraria Islandica.—A species of lichen found in Iceland and the mountainous parts of Europe; when boiled in water, it first swells up, and then yields a substance which gelatinizes on cooling.

It contains lichen starch; a bitter principle soluble in alcohol, termed “cetrarine;” and common starch; traces of gallic acid and bitartrate of potash are also present.

IODINE.

Symbol, I. Atomic weight, 126.

Iodine is chiefly prepared at Glasgow, from *kelp*, which is the fused ash obtained by burning seaweeds. The waters of the ocean contain minute quantities of the iodides of sodium and magnesium, which are separated and stored up by the growing tissues of the marine plant.

In the preparation, the mother-liquor of kelp is evaporated to dryness and distilled with sulphuric acid; the hydriodic acid first liberated is decomposed by the high

temperature, and fumes of iodine condense in the form of opaque crystals.

Properties.—Iodine has a bluish-black color and metallic lustre; it stains the skin yellow, and has a pungent smell, like diluted chlorine. It is extremely volatile when moist, boils at 350° , and produces dense violet-colored fumes, which condense in brilliant plates. Specific gravity 4.946. Iodine is very sparingly soluble in water, 1 part requiring 7000 parts for perfect solution: even this minute quantity however tinges the liquid of a brown color. Alcohol and ether dissolve it more abundantly, forming dark-brown solutions. Iodine also dissolves freely in solutions of the alkaline iodides, such as the iodide of potassium, of sodium, and of ammonium.

Chemical Properties.—Iodine belongs to the chlorine group of elements, characterized by forming acids with hydrogen, and combining extensively with the metals (see chlorine). They are however comparatively indifferent to oxygen, and also to each other. The iodides of the alkalis and alkaline earths are soluble in water; also those of iron, zinc, cadmium, etc. The iodides of lead, silver, and mercury are nearly or quite insoluble.

Iodine possesses the property of forming a compound of a deep blue color with starch. In using this as a test, it is necessary first to liberate the iodine (if in combination), by means of chlorine, or nitric acid saturated with peroxide of nitrogen. The presence of alcohol or ether interferes to a certain extent with the result.

IODIDE OF AMMONIUM.

Symbol, NH_4I . Atomic weight, 144.

This salt may be prepared by adding carbonate of am-

monia to iodide of iron, but more easily by the following process:—A strong solution of hydrosulphate of ammonia is first made, by passing sulphuretted hydrogen gas into liquor ammoniæ. To this liquid iodine is added until the whole of the sulphuret of ammonium has been converted into iodide. When this point is reached, the solution at once colors brown from solution of free iodine. On the first addition of the iodine, an escape of sulphuretted hydrogen gas and a dense deposit of sulphur take place. After the decomposition of the hydrosulphate of ammonia is complete, a portion of hydriodic acid—formed by the mutual reaction of sulphuretted hydrogen and iodine—attacks any carbonate of ammonia which may be present, and causes an effervescence. The effervescence being over, the liquid is still acid to test-paper, from excess of hydriodic acid; it is to be cautiously neutralized with ammonia, and evaporated by the heat of a water-bath to the crystallizing point.

The crystals should be thoroughly dried over a dish of sulphuric acid, and then sealed in small tubes containing each about half a drachm of the salt; by this means it will be preserved colorless.

Iodide of ammonium is very soluble in alcohol, but it is not advisable to keep it in solution, from the rapidity with which it decomposes and becomes brown.

The most common impurity of commercial iodide of ammonium is sulphate of ammonia; it is detected by its sparing insolubility in alcohol.

IODIDE OF CADMIUM.

Symbol, CdI . Atomic weight, 182.

This salt is formed by heating filings of metallic cad-

mium with iodine, or by mixing the two together with addition of water. It is useful in iodizing collodion intended for keeping, since it does not become brown from liberation of free iodine with the same rapidity as the alkaline iodides.

Iodide of cadmium is very soluble both in alcohol and water; the solution yielding on evaporation large six-sided tables of a pearly lustre, which are permanent in the air. The crystalline form of this salt is a sufficient criterion of its purity.

IODIDE OF IRON.

Symbol, FeI . Atomic weight, 154.

Iodide of iron, in a fit state for photographic use, is easily obtained by dissolving a drachm of iodine in an ounce of *proof spirit*—that is, a mixture of equal bulks of spirits of wine and water—and adding an excess of iron filings. After a few hours, a green solution is obtained without the aid of heat. The presence of metallic iron in excess prevents the liberation of iodine and deposit of peroxide of iron which would otherwise speedily occur. It is very soluble in water and alcohol, but the solution rapidly absorbs oxygen and deposits peroxide of iron; hence the importance of preserving it in contact with metallic iron, with which the separated iodine may recombine. By very careful evaporation, hydrated crystals of proto-iodide may be obtained, but the composition of the solid salt usually sold under that name cannot be depended on.

The *periodide* of iron, corresponding to the *perchloride*, has not been examined, and it is doubtful if any such compound exists.

IODIDE OF POTASSIUM.

Symbol, KI. Atomic weight, 166.

This salt is usually formed by dissolving iodine in solution of potash until it begins to acquire a brown color ; a mixture of iodide of potassium and *iodate of potash* (KO IO_5) is thus formed ; but by evaporation and heating to redness, the latter salt parts with its oxygen, and is converted into iodide of potassium.

Properties.—It forms cubic and prismatic crystals, which should be hard, and *very slightly or not at all deliquescent*. Soluble in less than an equal weight of water at 60° ; it is also soluble in alcohol, but not in ether. The proportion of iodide of potassium contained in a saturated alcoholic solution, varies with the strength of the spirit,—with common spirits of wine, sp. gr. $\cdot 836$, it would be about 8 grains to the drachm ; with alcohol rectified from carbonate of potash, sp. gr. $\cdot 823$, 4 or 5 grains : with absolute alcohol, 1 to 2 grains. The solution of iodide of potassium is instantly colored brown by free chlorine ; also very rapidly by peroxide of nitrogen ; ordinary acids, however, act less quickly, hydriodic acid being first formed, and subsequently decomposing spontaneously.

Iodide of potassium, as sold in the shops, is often contaminated with various impurities. The first and most remarkable is *carbonate of potash*. When a sample of iodide of potassium contains much carbonate of potash, it forms small and imperfect crystals, which are strongly alkaline to test-paper, and become moist on exposure to the air, from the deliquescent nature of the alkaline carbonate. *Sulphate of potash* is also a common impurity ; it may be detected by chloride of barium.

Chloride of potassium is another impurity; it is detected as follows:—Precipitate the salt by an equal weight of nitrate of silver, and treat the yellow mass with solution of ammonia; if any chloride of silver is present, it dissolves in the ammonia, and after filtration is re-precipitated in white curds by the addition of an excess of pure nitric acid. If the nitric acid employed is not pure, but contains traces of free chlorine, the iodide of silver must be well washed with distilled water before treating it with ammonia, or the excess of free nitrate of silver dissolving in the ammonia would, on neutralizing, produce chloride of silver, and so cause an error.

Iodide of potash is a fourth impurity often found in iodide of potassium: to detect it, add a drop of dilute sulphuric acid, or a crystal of citric acid, to the solution of the iodide; when, if much iodate be present, the liquid will become yellow from liberation of free iodine. The *rationale* of this reaction is as follows:—The sulphuric acid unites with the base of the salt, and liberates hydriodic acid (HI), a *colorless compound*; but if iodic acid (IO_5) be also present, it decomposes the hydriodic acid first formed, oxidizing the hydrogen into water (HO), and setting free the iodine. The immediate production of a yellow color on adding a weak acid to aqueous solution of iodide of potassium is, therefore, a proof of the presence of an iodate. As iodate of potash is thought to render collodion insensitive (?), this point should be attended to.

Iodide of potassium may be rendered very pure by recrystallizing from spirit, or by dissolving in strong alcohol of sp. gr. .823, in which sulphate, carbonate, and iodate of potash are insoluble. The proportion of iodide

of potassium contained in saturated alcoholic solutions varies with the strength of the spirit.

Solution of chloride of barium is commonly used to detect impurities in iodide of potassium ; it forms a white precipitate if carbonate, iodate, or sulphate be present. In the two former cases the precipitate dissolves on the addition of *pure* dilute nitric acid, but in the latter it is insoluble. The commercial iodide, however, is rarely so pure as to remain quite clear on the addition of chloride of barium, a *mere opalescence*, therefore, may be disregarded.

IODIDE OF SILVER. (See Silver, Iodide of.)

IRON, PROTOSULPHATE OF.

Symbol, $\text{FeO SO}_3 + 7 \text{HO}$. Atomic weight, 139.

This salt, often termed *copperas* or *green vitriol*, is a most abundant substance, and used for a variety of purposes in the arts. Commercial sulphate of iron, however, being prepared on a large scale, requires recrystallization to render it sufficiently pure for photographic purposes.

Pure sulphate of iron occurs in the form of large, transparent prismatic crystals, of a delicate green color : by exposure to the air they gradually absorb oxygen and become rusty on the surface. Solution of sulphate of iron, colorless at first, afterwards changes to a red tint, and deposits a brown powder ; this powder is a *basic* persulphate of iron, that is, a persulphate containing an excess of the oxide or *base*. By the addition of sulphuric or acetic acid to the solution, the formation of a *deposit* is prevented, the brown powder being soluble in acid liquids.

The crystals of sulphate of iron include a large quan-

tity of water of crystallization, a part of which they lose by exposure to dry air. By a higher temperature, the salt may be rendered perfectly *anhydrous*, in which state it forms a white powder.

Aqueous solution of sulphate of iron absorbs the *binoxide of nitrogen*, acquiring a deep olive-brown color: as this gaseous binoxide is itself a reducing agent, the liquid so formed has been proposed as a more energetic developer than the sulphate of iron alone.

IRON, PROTONITRATE OF.

Symbol, $\text{FeO NO}_5 + 7 \text{HO}$. Atomic weight, 153.

This salt, by careful evaporation *in vacuo* over sulphuric acid, forms transparent crystals, of a light green color, and containing 7 atoms of water, like the protosulphate. It is exceedingly unstable, and soon becomes red from decomposition, unless preserved from contact with air.

The following process is commonly followed for preparing protonitrate of iron:—

Take of nitrate of baryta 300 grains; powder and dissolve by the aid of heat in three ounces of water; then throw in, by degrees, with constant stirring, crystallized sulphate of iron, *powdered*, 320 grains. Continue to stir for about five or ten minutes. Allow to cool, and filter from the white deposit, which is the insoluble sulphate of baryta.

In place of nitrate of baryta, the nitrate of lead may be used (sulphate of lead being an insoluble salt), but the quantity required will be different. The atomic weights of nitrate of baryta and nitrate of lead are as 131 to 166; consequently 300 grains of the former are equivalent to 380 grains of the latter.

IRON, PERCHLORIDE OF.

Symbol, Fe_2Cl_3 . Atomic weight, 164.

There are two chlorides of iron, corresponding in composition to the protoxide and the sesquioxide respectively. The protochloride is very soluble in water, forming a green solution, which precipitates a dirty white protoxide on the addition of an alkali. The perchloride, on the other hand, is dark brown, and gives a foxy-red precipitate with alkalis.

Properties.—Perchloride of iron may be obtained in the solid form by heating iron wire in excess of chlorine; it condenses in the shape of brilliant and iridescent brown crystals, which are volatile, and dissolve in water, the solution being acid to test-paper. It is also soluble in alcohol, forming the *tinctura ferri sesquichloridi* of the Pharmacopœia. Commercial perchloride of iron ordinarily contains an excess of hydrochloric acid.

LITMUS.

Litmus is a vegetable substance, prepared from various *lichens*, which are principally collected on rocks adjoining the sea. The coloring matter is extracted by a peculiar process, and afterwards made up into a paste with chalk, plaster of Paris, &c.

Litmus occurs in commerce in the form of small cubes, of a fine violet color. In using it for the preparation of test-papers, it is digested in hot water, and sheets of porous paper are soaked in the blue liquid so formed. The red papers are prepared at first in the same manner, but afterwards placed in water which has been rendered faintly acid with sulphuric or hydrochloric acid.

MERCURY, BICHLORIDE OF.

Symbol, HgCl_2 . Atomic weight, 274.

This salt, also called corrosive sublimate, and sometimes *chloride of mercury* (the atomic weight of mercury being halved), may be formed by heating mercury in excess of chlorine, or, more economically, by subliming a mixture of persulphate of mercury and chloride of sodium.

Properties.—a very corrosive and poisonous salt, usually sold in semi-transparent, crystalline masses, or in the state of powder. Soluble in 16 parts of cold, and in 3 of hot water; more abundantly so in alcohol, and also in ether. The solubility in water may be increased almost to any extent by the addition of free hydrochloric acid.

The protochloride of mercury is an insoluble white powder, commonly known under the name of *calomel*.

MILK.

The milk of herbivorous animals contains three principal constituents—fatty matter, caseine, and sugar; in addition to these, small quantities of the chloride of potassium, and of phosphates of lime and magnesia, are present.

The fatty matter is contained in small cells, and forms the greater part of the cream which rises to the surface of the milk on standing. hence *skimmed* milk is to be preferred for photographic use.

The second constituent, *caseine*, is an organic principle somewhat analogous to albumen in composition and properties. Its aqueous solution however does not, like albumen, *coagulate* on boiling, unless *an acid* be present, which probably removes a small portion of alkali with which the caseine was previously combined. The sub-

stance termed "rennet," which is the dried stomach of the calf, possesses the property of coagulating caseine, but the exact mode of its action is unknown. Sherry wine is also employed to curdle milk; but brandy and other spirituous liquids, when free from acid and astringent matter, have no effect.

In all these cases a proportion of the caseine usually remains in a soluble form in the *whey*; but when the milk is coagulated by the addition of acids, the quantity so left is very small, and hence the use of the rennet is to be preferred, since the presence of caseine facilitates the reduction of the sensitive silver salts.

Caseine combines with oxide of silver in the same manner as albumen, forming a white coagulum, which becomes *brick-red* on exposure to light.

Sugar of milk, the third principal constituent, differs from both cane and grape sugar; it may be obtained by evaporating *whey* until crystallization begins to take place. It is hard and gritty, and only slightly sweet; slowly soluble, without forming a syrup, in about two and a half parts of boiling, and six of cold water. It does not ferment and form alcohol on the addition of yeast, like grape sugar, but by the action of *decomposing animal matter* is converted into lactic acid.

When skimmed milk is exposed to the air for some hours it gradually becomes *sour*, from lactic acid formed in this way; and if then heated to ebullition, the caseine coagulates very perfectly.

NITRIC ACID.

Symbol, NO_5 . Atomic weight, 54.

Nitric acid, or *aqua-fortis*, is prepared by adding sul-

phuric acid to nitrate of potash, and distilling the mixture in a retort. Sulphate of potash and free nitric acid are formed, the latter of which, being volatile, distils over in combination with one atom of water previously united with sulphuric acid.

Properties.—Anhydrous nitric acid is a solid substance, white and crystalline, but it cannot be prepared except by an expensive and complicated process.

The concentrated liquid nitric acid contains 1 atom of water, and has a sp. gr. of about 1.5: if perfectly pure it is colorless, but usually it has a slight yellow tint, from partial decomposition into peroxide of nitrogen: it fumes strongly in the air.

The strength of commercial nitric acid is subject to much variation. An acid of sp. gr. 1.42, containing about 4 atoms of water, is commonly met with. If the specific gravity is much lower than this (less than 1.36), it will scarcely be adapted for the preparation of peroxyline. The yellow *nitrous acid*, so called, is a strong nitric acid partially saturated with the brown vapors of peroxide of nitrogen; it has a high specific gravity, but this is somewhat deceptive, being caused in part by the presence of the peroxide. On mixing with sulphuric acid the color disappears, a compound being formed which has been termed a *sulphate of nitrous acid*.

Chemical properties.—Nitric acid is a powerful oxidizing agent; it dissolves all the common metals, with the exception of gold and platinum. Animal substances, such as the cuticle, nails, etc., are tinged of a permanent yellow color, and deeply corroded by a prolonged application. Nitric acid forms a numerous class of salts, all of which are soluble in water. Hence its presence cannot be deter-

mined by any precipitating re-agent, in the same manner as that of hydrochloric and sulphuric acid.

Impurities of Commercial Nitric Acid.—These are principally *chlorine* and *sulphuric acid*; also peroxide of nitrogen, which tinges the acid yellow, as already described. Chlorine is detected by diluting the acid with an equal bulk of distilled water, and adding a few drops of nitrate of silver,—a *miliness*, which is chloride of silver in suspension, indicates the presence of chlorine. In testing for sulphuric acid, dilute the nitric acid as before, and drop in a *single drop* of solution of chloride of barium; if sulphuric acid be present, an insoluble precipitate of sulphate of baryta will be formed.

NITROUS ACID. (See Silver, Nitrate of.)

NITRATE OF POTASH.

Symbol, KO NO_3 . Atomic weight, 102.

This salt, also termed *nitre* or *saltpetre*, is an abundant natural product, found effloresced upon the soil in certain parts of the East Indies. It is also produced artificially in what are called nitre-beds.

Nitrate of potash is an *anhydrous salt*,—it contains simply nitric acid and potash, without any water of crystallization; still, in many cases, a little water is retained mechanically between the interstices of the crystals, and therefore it is better to dry before use. This may be done by laying it in a state of fine powder upon blotting-paper, close to a fire, or upon a heated metallic plate.

NITRATE OF BARYTA.

Symbol, BaO NO_3 . Atomic weight, 131.

Nitrate of baryta forms octahedral crystals, which are

anhydrous. It is considerably less soluble than the chloride of barium, requiring 12 parts of cold and 4 of boiling water for solution. It may be substituted for the nitrate of lead in the preparation of protonitrate of iron.

NITRATE OF LEAD.

Symbol, PbO NO_3 . Atomic weight, 166.

Nitrate of lead is obtained by dissolving the metal, or the oxide of lead, in *excess* of nitric acid, diluted with 2 parts of water. It crystallizes on evaporation in white anhydrous tetrahedra and octahedra, which are hard, and decrepitate on being heated; they are soluble in 8 parts of water at 60° .

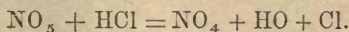
Nitrate of lead forms with sulphuric acid, or soluble sulphates, a white precipitate, which is the insoluble sulphate of lead. The *Iodide* of lead is also very sparingly soluble in water.

NITRATE of SILVER. (*See Silver, Nitrate of.*)

NITRO-HYDROCHLORIC ACID.

Symbol, $\text{NO}_4 + \text{Cl}$.

This liquid is the aqua-regia of the old alchemists. It is produced by mixing nitric and hydrochloric acids: the oxygen contained in the former combines with the hydrogen of the latter, forming water and liberating chlorine, thus:—



The presence of free chlorine confers on the mixture the

power of dissolving gold and platinum, which neither of the two acids possesses separately. In preparing aqua-regia it is usual to mix one part, by measure, of nitric acid with four of hydrochloric acid, and to dilute with an equal bulk of water. The application of a gentle heat assists the solution of the metal; but if the temperature rises to the boiling point, a violent effervescence and escape of chlorine takes place.

OXYGEN.

Symbol, O. Atomic weight, 8.

Oxygen gas may be obtained by heating nitrate of potash to redness, but in this case it is contaminated with a portion of nitrogen. The salt termed chlorate of potash (the composition of which is closely analogous to that of the nitrate, chlorine being substituted for nitrogen) yields abundance of pure oxygen gas on the application of heat, leaving behind chloride of potassium.

Chemical Properties.—Oxygen combines eagerly with many of the chemical elements, forming oxides. This chemical affinity however is not well seen when the elementary body is exposed to the action of *oxygen in the gaseous form*. It is the *nascent* oxygen which acts most powerfully as an oxidizer. By nascent oxygen is meant oxygen on the point of separation from other elementary atoms with which it was previously associated; it may then be considered to be in the liquid form, and hence it comes more perfectly into contact with the particles of the body to be oxidized.

Illustrations of the superior chemical energy of nascent oxygen are numerous, but none perhaps are more striking

than the mild and gradual oxidizing influence exerted by atmospheric air, as compared with the violent action of nitric acid and bodies of that class which contain oxygen loosely combined.

OXYMEL.

This syrup of honey and vinegar is prepared as follows:—Take of

Honey	1 pound.
Acid, acetic, fortiss. (Beaufoy's acid)	11 drachms.
Water	13 drachms.

Stand the pot containing the honey in boiling water until a scum rises to the surface, which is to be removed two or three times. Then add the acetic acid and water, and skim once more if required. Allow to cool, and it will be fit for use.

POTASH.

Symbol, $KO + HO$. Atomic weight, 57.

Potash is obtained by separating the carbonic acid from carbonate of potash by means of caustic lime. Lime is a more feeble base than potash, but the carbonate of lime, being *insoluble* in water, is at once formed on adding milk of lime to a solution of carbonate of potash.

Properties:—Usually met with in the form of solid lumps, or in cylindrical sticks, which are formed by melting the potash and running it into a mould. It always contains some atom of water, which cannot be driven off by the application of heat.

Potash is soluble almost to any extent in water, much heat being evolved. The solution is powerfully alkaline and acts rapidly upon the skin; it dissolves fatty and

resinous bodies, converting them into soaps: Solution of potash absorbs carbonic acid quickly from the air, and should therefore be preserved in stoppered bottles; the glass stoppers must be wiped occasionally, in order to prevent them from becoming immovably fixed by the solvent action of the potash upon the silica of the glass.

The liquor potassæ of the London Pharmacopœia has a sp. gr. of 1.063, and contains about 5 per cent. of real potash. It is usually contaminated with *carbonate* of potash, which causes it to effervesce on the addition of acids; also, to a less extent, with sulphate of potash, chloride of potassium, silica, etc.

POTASH, CARBONATE OF.

Symbol, KO CO_2 . Atomic weight, 70.

The impure carbonate of potash, termed *pearlash*, is obtained from the ashes of wood and vegetable matter, in the same manner as carbonate of soda is prepared from the ashes of seaweeds. Salts of potash and of soda appear essential to vegetation, and are absorbed and approximated by the living tissues of the plant. They exist in the vegetable structure combined with organic acids in the form of salts, like the oxalate, tartrate, etc., which when burned are converted into carbonates.

Properties.—The pearlash of commerce contains large and variable quantities of chloride of potassium, sulphate of potash, etc. A purer carbonate is sold, which is free from sulphates, and with only a trace of chlorides. Carbonate of potash is a strongly alkaline salt, deliquescent, and soluble in twice its weight of cold water; insoluble in alcohol, and employed to deprive it of water.

PYROGALLIC ACID.

Symbol, $C_8H_4O_4$ (Stenhouse). Atomic weight, 84.

The term *pyro* prefixed to gallic acid implies that the new substance is obtained by the *action of heat* upon that body. At a temperature of about 410° Fahr., gallic acid is decomposed, and a white sublimate forms, which condenses in lamellar crystals; this is pyrogallie acid.

Pyrogallie acid is very soluble in cold water, and in alcohol and ether; the solution decomposes and becomes brown by exposure to the air. It gives an indigo blue color with protosulphate of iron, which changes to dark green if any persulphate be present.

Although termed an *acid*, this substance is strictly *neutral*; it does not redden litmus-paper, and forms no salts. The addition of potash or soda decomposes pyrogallie acid, at the same time increasing the attraction for oxygen; hence this mixture may conveniently be employed for absorbing the oxygen contained in atmospheric air. The compounds of silver and gold are reduced by pyrogallie acid even more rapidly than by gallic acid, the reducing agent absorbing the oxygen, and becoming converted into carbonic acid and a brown matter insoluble in water.

Commercial pyrogallie acid is often contaminated with empyreumatic oil, and also with a black insoluble substance known as *metagallie acid*, which is formed when the heat is raised above the proper temperature in the process of manufacture.

SEL D'OR. (See Gold, Hyposulphite of.)

SILVER.

Symbol, Ag. Atomic weight, 108.

This metal, the *luna* or *diana* of the alchemists, is found

native in Peru and Mexico; it occurs also in the form of sulphuret of silver.

When pure it has a sp. gr. of 10·5, and is very malleable and ductile; melts at a bright red heat. Silver does not oxidize in the air, but when exposed to an impure atmosphere containing traces of sulphuretted hydrogen, it is slowly tarnished from formation of sulphuret of silver. It dissolves in sulphuric acid, but the best solvent is nitric acid.

The standard coin of the realm is an alloy of silver and copper, containing about one-eleventh of the latter metal. It may be converted into nitrate of silver, sufficiently pure for photographic purposes, by dissolving it in nitric acid and evaporating the solution to the crystallizing point: or, if the quantity be small, the solution may be boiled down to complete dryness, and the residue *fused* strongly; which decomposes the nitrate of copper, but leaves the greater portion of the silver salt unaffected. (N. B. Nitrate of silver which has undergone fusion contains nitrite of silver, and will require the addition of acetic acid if used for preparing the collodion sensitive film:)

SILVER, AMMONIO-NITRATE OF.

Crystallized nitrate of silver absorbs ammoniaical gas rapidly, with production of heat sufficient to fuse the resulting compound, which is white, and consists of 100 parts of the nitrate + 29·5 of ammonia. The compound however which photographers employ under the name of ammonio-nitrate of silver, may be viewed more simply as a solution of the oxide of silver in ammonia, without re-

ference to the nitrate of ammonia necessarily produced in the reaction.

Very strong ammonia, in acting upon oxide of silver, converts it into a black powder, termed *fulminating silver*, which possesses the most dangerous explosive properties. Its composition is uncertain. In preparing ammonio-nitrate of silver by the common process, the oxide first precipitated occasionally leaves a little black powder behind, on re-solution; this does not appear, however, according to the observations of the author, to be fulminating silver.

In sensitizing salted paper by the ammonio-nitrate of silver, *free ammonia* is necessarily formed. Thus:—

Chloride of ammonium + oxide of silver in ammonia
= chloride of silver + ammonia + water.

SILVER, OXIDE OF.

Symbol, AgO. Atomic weight, 116.

If a little potash or ammonia be added to solution of nitrate of silver, a brown substance is formed, which, on standing, collects at the bottom of the vessel. This is oxide of silver, displaced from its previous state of combination with nitric acid by the stronger oxide, potash. Oxide of silver is soluble *to a very minute extent* in pure water, the solution possessing an alkaline reaction to litmus; it is easily dissolved by nitric or acetic acid, forming a neutral nitrate or acetate; also soluble in ammonia (ammonio-nitrate of silver), and in nitrate of ammonia hyposulphite of soda, and cyanide of potassium. Long exposure to light converts it into a black substance, which is probably a suboxide.

Properties of the Suboxide of Silver.—Suboxide of silver bears the same relation to the ordinary brown protoxide of silver that subchloride bears to protochloride of silver.

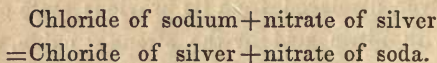
It is a black powder, which assumes the metallic lustre on rubbing, and when treated with dilute acids is resolved into protoxide of silver which dissolves, and metallic silver.

SILVER, CHLORIDE OF.

Symbol, AgCl. Atomic weight, 144.

Preparation of Chloride of Silver by double decomposition.—In order to illustrate this, take a solution in water of chloride of sodium or “common salt,” and mix it with a solution containing nitrate of silver; immediately a dense, curdy, white precipitate falls, which is the substance in question.

In this reaction the elements change places; the chlorine leaves the sodium with which it was previously combined, and crosses over to the silver; the oxygen and nitric acid are released from the silver, and unite with the sodium: thus



This interchange of elements is termed by chemists *double decomposition*.

The essential requirements in two salts intended for the preparation of chloride of silver, are simply that the first should contain chlorine, the second silver, and that both should be soluble in water; hence the chloride of potassium or ammonium may be substituted for the chloride of

sodium, and the sulphate or acetate for the nitrate of silver.

In preparing chloride of silver by double decomposition, the white clotty masses which first form must be washed repeatedly with water, in order to free them from soluble nitrate of soda, the other product of the change. When this is done, the salt is in a pure state, and may be dried, etc., in the usual way.

Properties of Chloride of Silver.—Chloride of silver differs in appearance from the nitrate of silver. It is not met with in crystals, but forms a soft white powder resembling common chalk or whiting. It is tasteless and insoluble in water; unaffected by boiling with the strongest nitric acid, but sparingly dissolved by concentrated hydrochloric acid.

Ammonia dissolves chloride of silver freely, as do solutions of hyposulphite of soda and cyanide of potassium. Concentrated solutions of alkaline chlorides, iodides, and bromides are likewise solvents of chloride of silver, but to a limited extent.

Dry chloride of silver heated to redness fuses, and concretes on cooling into a tough and semi-transparent substance, which has been termed *horn silver* or *luna cornea*.

Placed in contact with metallic zinc or iron acidified with dilute sulphuric acid, chloride of silver is reduced to the metallic state, the chlorine passing to the other metal under the decomposing influence of the galvanic current which is established.

Preparation and properties of the Subchloride of Silver.—If a plate of polished silver be dipped in solution of perchloride of iron, or of bichloride of mercury, a *black stain* is produced, the iron or mercury salt losing a portion of

chlorine, which passes to the silver and converts it superficially into subchloride of silver. This compound differs from the white chloride of silver in containing less chlorine and more of the metallic element; the composition of the latter being represented by the formula AgCl. , that of the former may perhaps be written as $\text{Ag}_2\text{Cl. (?)}$

Subchloride of silver is interesting to the photographer as corresponding in properties and composition with the ordinary chloride of silver blackened by light. It is a pulverulent substance of a bluish-black color, which is decomposed by ammonia, hyposulphite of soda, and cyanide of potassium, into chloride of silver which dissolves, and insoluble metallic silver.

SILVER, BROMIDE OF.

Symbol, AgBr. Atomic weight, 186.

This substance so closely resembles the corresponding salts containing chlorine and iodine, that a short notice of it will suffice.

Bromide of silver is prepared by exposing a silvered plate to the vapor of bromine, or by adding solution of bromide of potassium to nitrate of silver. It is an insoluble substance, slightly yellow in color, and distinguished from iodide of silver by dissolving in strong ammonia and in chloride of ammonium. It is freely soluble in hyposulphite of soda and in cyanide of potassium.

SILVER, CITRATE OF. (*See Citric Acid.*)

SILVER, IODIDE OF.

Symbol, AgI. Atomic weight, 234.

Preparation and Properties of Iodide of Silver.—Iodide of silver may be formed in an analogous manner to the

chloride, viz. by the direct action of the vapor of iodine upon metallic silver, or by double decomposition between solutions of iodide of potassium and nitrate of silver.

When prepared by the latter mode it forms an impalpable powder, the color of which varies slightly with the manner of precipitation. If the iodide of potassium be in excess, the iodide of silver falls to the bottom of the vessel nearly white; but with an excess of nitrate of silver it is of a straw-yellow tint. This point may be noticed, because the yellow salt is the one adapted for photographic use, the other being insensible to the influence of light.

Iodide of silver is tasteless and inodorous; insoluble in water and in dilute nitric acid. It is scarcely dissolved by ammonia, which serves to distinguish it from the chloride of silver, freely soluble in that liquid. Hyposulphite of soda and cyanide of potassium both dissolve iodide of silver; it is also soluble in solutions of the alkaline bromides and iodides.

SILVER, FLUORIDE OF.

Symbol, AgF . Atomic weight, 127.

This compound differs from those just described in being soluble in water. The dry salt fuses on being heated, and is reduced by a higher temperature, or by exposure to light.

SILVER, SULPHURET OF.

Symbol, AgS . Atomic weight, 124.

This compound is formed by the action of sulphur upon metallic silver, or of sulphuretted hydrogen, or hydrosul-

phate of ammonia, upon the silver salts ; the decomposition of hyposulphite of silver also furnishes the black sulphuret.

Sulphuret of silver is insoluble in water, and nearly so in those substances which dissolve the chloride, bromide, and iodide, such as ammonia, hyposulphites, cyanides, etc. ; but it dissolves in nitric acid, being converted into soluble sulphate and nitrate of silver.

SILVER, NITRATE OF.

Symbol, AgO NO_5 . Atomic weight, 170.

Nitrate of silver is prepared by dissolving metallic silver in nitric acid. Nitric acid is a powerfully acid and corrosive substance, containing two elementary bodies united in definite proportions. These are nitrogen and oxygen ; the latter being present in greatest quantity.

Nitric acid is a powerful solvent for the metallic bodies generally. To illustrate its action in that particular, as contrasted with other acids, place pieces of silver foil in two test-tubes, the one containing dilute sulphuric, the other dilute nitric acid ; on the application of heat a violent action soon commences in the latter, but the former is unaffected. In order to understand the cause of the difference, it must be borne in mind that when a metallic substance dissolves in an acid, the nature of the solution is unlike that of an *aqueous* solution of salt or sugar. If you take salt water, and boil it down until the whole of the water has evaporated, you obtain the salt again, with properties the same as at first ; but if a similar experiment be made with a solution of silver in nitric acid, the result is different : in that case you do not get metallic

silver on evaporation, but silver *combined with oxygen and nitric acid*, both of which are tightly retained, being, in fact, in a state of chemical combination with the metal.

If we closely examine the effects produced by treating silver with nitric acid, we find them to be of the following nature:—first, a certain amount of oxygen is imparted to the metal, so as to form an *oxide*, and afterwards this oxide dissolves in another portion of the nitric acid, producing *nitrate* of the oxide, or, as it is shortly termed, nitrate of silver.

It is therefore the *instability* of nitric acid, its proneness to part with oxygen, which renders it superior to sulphuric acid in the experiment of dissolving silver. Nitric acid stands high in the list of “oxidizing agents,” and it is important that the photographer should bear this fact in mind.

Properties of Nitrate of Silver.—In the preparation of nitrate of silver, when the metal has dissolved, the solution is boiled down in order to drive off the excess of nitric acid, and set aside to crystallize. The salt, however, as so obtained is still acid to test-paper, and requires either re-crystallization, or a careful heating to about 300° Fahrenheit, to render it perfectly neutral.

Pure nitrate of silver occurs in the form of white crystalline plates, which are very heavy and dissolve readily in an equal weight of cold water. The solubility is much lessened by the presence of free nitric acid, and in the *concentrated* nitric acid the crystals are almost insoluble. Boiling alcohol takes up about one-fourth part of its weight of the crystallized nitrate, but deposits nearly the whole on cooling. Nitrate of silver has an intensely bitter and nauseous taste; acting as a caustic, and corroding the

skin by a prolonged application. Its aqueous solution is perfectly neutral to test-paper.

Heated in a crucible the salt melts, and when poured into a mould and solidified, forms the *lunar caustic* of commerce. At a still higher temperature it is decomposed, and bubbles of oxygen gas are evolved. The melted mass, cooled and dissolved in water, leaves behind a black powder, and yields a solution which is faintly alkaline to test-paper. The alkalinity depends upon the presence of *nitrite* of silver associated with excess of oxide, in the form probably of a basic or *sub-nitrite* of silver.*

Solution of nitrate of silver is decomposed by iron, zinc, copper, mercury, etc., the nitric acid and oxygen passing to the other metal, and metallic silver being precipitated.

SILVER, NITRITE OF.

Symbol, AgO NO_3 . Atomic weight, 154.

Nitrite of silver is a compound of nitrous acid, or NO_3 , with oxide of silver. It is formed by heating nitrate of silver, so as to drive off a portion of its oxygen, or more conveniently, by mixing nitrate of silver and nitrate of potash in equal parts, fusing strongly, and dissolving in a small quantity of boiling water; on cooling, the nitrite crystallizes out, and may be purified by pressing in blotting paper. Mr. Hadow describes an economical method of preparing nitrite of silver in quantity, viz. by heating 1 part of starch in 8 of nitric acid of 1.25 specific gravity, and conducting the evolved gases into a solution of

* Nitrite of silver differs from the nitrate in containing less oxygen, and is formed from it by the abstraction of two atoms of that element.

pure carbonate of soda until effervescence has ceased. The nitrite of soda thus formed is afterwards added to nitrate of silver in the usual way.

Properties.—Nitrite of silver is soluble in 120 parts of cold water; easily soluble in boiling water, and crystallizes, on cooling, in long slender needles. It has a certain degree of affinity for oxygen, and tends to pass into the condition of nitrate of silver; but it is probable that its photographic properties depend more upon a decomposition of the salt and liberation of nitrous acid.

Properties of Nitrous Acid.—This substance possesses very feeble acid properties, its salts being decomposed even by acetic acid. It is an unstable body, and splits up, in contact with water, into binoxide of nitrogen and nitric acid. The peroxide of nitrogen, NO_4 , is also decomposed by water and yields the same products.

SILVER, ACETATE OF.

Symbol, AgO ($\text{C}^4\text{H}^3\text{O}^3$). Atomic weight, 167.

This is a difficultly soluble salt, deposited in lamellar crystals when an acetate is added to a strong solution of nitrate of silver. If *acetic acid* be used in place of an acetate, the acetate of silver does not fall so readily, since the nitric acid which would then be liberated impedes the decomposition.

SILVER, HYPOSULPHITE OF.

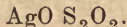
Symbol, $\text{AgO S}_2\text{O}_2$. Atomic weight, 164.

In order to understand more fully how *decomposition* of hyposulphite of silver may affect the process of fixing, the

peculiar properties of this salt should be studied. With this view nitrate of silver and hyposulphite of soda may be mixed in equivalent proportions, viz. about twenty-one grains of the former salt to sixteen grains of the latter, first dissolving each in separate vessels in half an ounce of distilled water. These solutions are to be added to each other and well agitated; immediately a dense deposit forms, which is hyposulphite of silver.

At this point a curious series of changes commences. The precipitate, at first white and curdy, soon alters in color: it becomes canary-yellow, then of a rich orange-yellow, afterwards liver-color, and finally black. The *rationale* of these changes is explained to a certain extent by studying the composition of the hyposulphite of silver.

The formula for this substance is as follows:—



But $\text{AgO S}_2\text{O}_2$ plainly equals AgS , or sulphuret of silver, and SO_3 , or sulphuric acid. The acid reaction assumed by the supernatant liquid is due therefore to sulphuric acid, and the black substance formed is sulphuret of silver. The yellow and orange-yellow compounds are earlier stages of the decomposition, but their exact nature is uncertain.

The instability of hyposulphite of silver is principally seen when it is in an isolated state: the presence of an excess of hyposulphite of soda renders it more permanent, by forming a double salt.

In fixing photographic prints this brown deposit of sulphuret of silver is very liable to form in the bath and upon the picture; particularly so when the *temperature* is high. To obviate it observe the following directions:—It is es-

pecially in the reaction between *nitrate of silver* and hyposulphite of soda that the blackening is seen ; the chloride and other *insoluble* salts of silver being dissolved, even to saturation, without any decomposition of the hyposulphite first formed. Hence, if the print be washed in water to remove the soluble nitrate, a very much weaker fixing bath than usual may be employed. This plan, however, involving a little additional trouble, is, on that account, often objected to, and, when such is the case, a *concentrated* solution of hyposulphite of soda must be used, in order to dissolve off the white hyposulphite of silver before it begins to decompose. When the proofs are taken at once from the printing frame and immersed in a *dilute* bath of hyposulphite (one part of the salt to six or eight of water), a *shade of brown* may often be observed to pass over the surface of the print, and a large deposit of sulphuret of silver soon forms as the result of this decomposition. On the other hand, with a strong hyposulphite bath there is little or no discoloration and the black deposit is absent.

But even if, by a preliminary removal of the nitrate of silver, the danger of blackening be in a great measure obviated, yet the print must not be taken out of the *fixing* bath too speedily, or some appearance of brown patches, visible by transmitted light, may occur.

Each atom of nitrate of silver requires *three* atoms of hyposulphite of soda to form the *sweet and soluble double salt*, and hence, if the action be not continued sufficiently long, another compound will be formed almost tasteless and insoluble. Even immersion in a new bath of hyposulphite of soda does not fix the print when once the yellow stage of decomposition has been established. This

yellow salt is insoluble in hyposulphite of soda, and consequently remains in the paper.

SUGAR OF MILK. (*See Milk.*)

SULPHURETTED HYDROGEN. (*See Hydrosulphuric Acid.*)

SULPHURIC ACID.

Symbol, SO_3 . Atomic weight, 40.

Sulphuric acid may be formed by oxidizing sulphur with boiling nitric acid; but this plan would be too expensive to be adopted on a large scale. The commercial process for the manufacture of sulphuric acid is exceedingly ingenious and beautiful, but it involves reactions which are too complicated to admit of a superficial explanation. The sulphur is first burnt into gaseous sulphurous acid (SO_2), and then, by the agency of binoxide of nitrogen gas, an additional atom of oxygen is imparted from the atmosphere, so as to convert the SO_2 into SO_3 , or sulphuric acid.

Properties.—Anhydrous sulphuric acid is a white crystalline solid. The strongest liquid acid always contains one atom of water, which is closely associated with it, and cannot be driven off by the application of heat.

This *mono-hydrated* sulphuric acid, represented by the formula HO SO_3 , is a dense fluid, having a specific gravity of about 1.845; boils at 620° , and distils without decomposition. It is not volatile at common temperatures, and therefore does not *fume* in the same manner as nitric or hydrochloric acid. The concentrated acid may be cooled down even to zero without solidifying; but a weaker com-

pound, containing twice the quantity of water, and termed *glacial* sulphuric acid, crystallizes at 40° Fahr. Sulphuric acid is intensely acid and caustic, but it does not destroy the skin or dissolve metals so readily as nitric acid. It has an energetic attraction for water, and when the two are mixed, condensation ensues, and much heat is evolved; four parts of acid and one of water produce a temperature equal to that of boiling water. Mixed with aqueous nitric acid, it forms the compound known as nitro-sulphuric acid.

Sulphuric acid possesses intense chemical powers, and displaces the greater number of ordinary acids from their salts. It *chars* organic substances, by removing the elements of water, and converts alcohol into ether in a similar manner. The *strength* of a given sample of sulphuric acid may generally be calculated from its specific gravity, and a table is given by Dr. Ure for that purpose.

Impurities of Commercial Sulphuric Acid.—The liquid acid sold as *oil of vitriol* is tolerably constant in composition, and seems to be as well adapted for photographic use as the *pure* sulphuric acid, which is far more expensive. The specific gravity should be about 1.836 at 60° . If a drop, evaporated upon platinum foil, gives a fixed residue, probably bisulphate of potash is present. A milkiness, on dilution, indicates sulphate of lead.

Test for Sulphuric Acid.—If the presence of sulphuric acid, or a soluble sulphate, be suspected in any liquid, it is tested for by adding a few drops of dilute solution of chloride of barium, or nitrate of baryta. A white precipitate, *insoluble in nitric acid*, indicates sulphuric acid. If the liquid to be tested is very acid, from nitric or hydrochloric acid, it must be largely diluted before testing, or a

crystalline precipitate will form, caused by the sparing solubility of the chloride of barium itself in acid solutions.

SULPHUROUS ACID.

Symbol, SO_2 . Atomic weight, 32.

This is a gaseous compound, formed by burning sulphur in atmospheric air or oxygen gas; also by heating oil of vitriol in contact with metallic copper, or with charcoal.

When an acid of any kind is added to hyposulphite of soda, sulphurous acid is formed as a product of the decomposition of hyposulphurous acid, but it afterwards disappears from the liquid by a secondary reaction, resulting in the production of trithionate and tetrathionate of soda.

Properties.—Sulphurous acid possesses a peculiar and suffocating odor, familiar to all in the fumes of burning sulphur. It is a feeble acid, and escapes with effervescence, like carbonic acid, when its salts are treated with oil of vitriol. It is soluble in water.

WATER.

Symbol, HO . Atomic weight, 9.

Water is an oxide of hydrogen, containing single atoms of each of the gases.

Distilled water is water which has been vaporized and again condensed: by this means it is freed from earthy and saline impurities, which, not being volatile, are left in the body of the retort. *Pure* distilled water leaves no residue on evaporation, and should remain perfectly clear on the addition of nitrate of silver, *even when exposed to the light*; it should also be neutral to test-paper.

The condensed water of steam-boilers sold as distilled water is apt to be contaminated with oily and empyreumatic matter, which discolours nitrate of silver, and is therefore injurious,

Rain-water, having undergone a natural process of distillation, is free from inorganic salts, but it usually contains a minute portion of *ammonia*, which gives it an alkaline reaction to test-paper. It is very good for photographic purposes if collected in clean vessels, but when taken from a common rain-water tank should always be examined, and if much organic matter be present, tinging it of a brown color and imparting an unpleasant smell, it must be rejected.

Spring or *river* water, commonly known as "hard water," usually contains sulphate of lime, and carbonate of lime dissolved in carbonic acid: also chloride of sodium in greater or less quantity. On boiling the water, the carbonic acid gas is evolved, and the greater part of the carbonate of lime (if any is present) deposits, forming an earthy incrustation on the boiler.

In testing water for sulphates and chlorides, acidify a portion with a few drops of *pure* nitric acid, free from chlorine (if this is not at hand, use pure acetic acid); then divide it into two parts, and add to the first a *dilute* solution of chloride of barium, and to the second nitrate of silver,—a milkiness indicates the presence of sulphates in the first case or of chlorides in the second. The *photographic nitrate bath* cannot be used as a test, since the iodide of silver it contains is precipitated on dilution, giving a milkiness which might be mistaken for chloride of silver.

Common hard water can often be used for making a nitrate bath when nothing better is at hand. The chlo-

rides it contains are precipitated by the nitrate of silver, leaving soluble *nitrates* in solution, which are not injurious. The carbonate of lime, if any is present, neutralizes free nitric acid, rendering the bath alkaline in the same manner as carbonate of soda. Sulphate of lime, usually present in well water, is said to exercise a retarding action upon the sensitive silver salts, but on this point the writer is unable to give certain information.

Hard water is not often sufficiently pure for the developing fluids. The chloride of sodium it contains decomposes the nitrate of silver upon the film, and the image cannot be brought out perfectly. The New River water, however supplied to many parts of London, is almost free from chlorides and answers very well. In other cases a few drops of nitrate of silver solution may be added to separate the chlorine, taking care not to use a large excess.

BLACK VARNISH.

Asphaltum, dissolved in Spirits or Oil of Turpentine.—The asphaltum may be coarsely pulverized and put into a bottle containing the turpentine, and in a few hours, if it be occasionally shaken, it will be dissolved and ready for use. It should be of about the consistency of thick paste.

I use the above, but will now give two more compositions, for any who may wish to adopt them :

Black Japan.—Boil together a gallon of boiled linseed oil, 8 ounces of amber, and 3 ounces of asphaltum. When sufficiently cool, thin it with oil of turpentine.

Brunswick Black.—Melt 4 lbs. of asphaltum, add 2 lbs. of hot boiled linseed oil, and when sufficiently cool, add a gallon of oil of turpentine.

The following is from Humphrey's Journal, Vol. viii, number 16.

Black Varnish.—I generally purchase this from the dealer ; but I have made an article which answered the purpose well, by dissolving pulverized asphaltum in spirits of turpentine. Any of the black varnishes can be improved by the addition of a little bees'-wax to it. It is less liable to crack and gives an improved gloss.

Before closing this chapter, it has been thought advisable to remark, that one of the most important departments of Photography is the practice of its chemistry. Many of the annoying failures experienced by those who are just engaging in the practice of the art, arise from the want of good and pure chemical agents, and the most

certain way to avoid this, is to purchase them only from persons who thoroughly understand both their nature and mode of application. As many who may read this work might wish to know the prices of the various articles employed in the practice of the processes given, they can be informed by addressing the author, who will furnish them with a printed Price List.

PRACTICAL DETAILS
OF THE
P O S I T I V E
OR
AMBROTYPE PROCESS.

CHAPTER IV.

LEWIS'S PATENT VICES FOR HOLDING THE GLASS—CLEAN-
ING AND DRYING THE GLASS—COATING—EXPOSURE IN
THE CAMERA—DEVELOPING—FIXING OR BRIGHTENING
—BACKING UP, &c.

MANIPULATIONS.

Under the head of manipulations I give the method I employ, and avoid confusion by omitting all comments upon the thousand suggestions of others.

The glass is to have its sharp edges and corners removed, by drawing a file once or twice over it. The article used for holding the glass is called a vice. This vice is firmly secured to a bench.

[Since the foregoing pages have been in type there has been introduced into market a new patent vice, adopted both for glass and plate blocks. I find it, although a little more expensive, an article better suited to the wants of the operator or amateur. It is called Lewis's Patent Glass Vice.]

Clasp the glass firmly in the vice, and pour or *spurt* upon it a little alcohol and rotten stone, previously formed into a paste, and then, with a piece of cotton flannel, the same as used in the daguerreotype, rub the glass until it is perfectly cleansed from all foreign substances, which will soon be known by experience. The rotten stone

paste should not be allowed to dry while rubbing, as it is more liable to scratch the glass. I use another small bottle containing clear alcohol, which I spurt upon the glass, to obviate the drying.

When the glass has been sufficiently cleaned, it should, while wet, be put in a vessel of water for future rinsing. Clean, as before, as many plates of glass as may be required, and when enough are ready, rinse them off in the water, and then in a quantity of clean water, or a running current, give them a second thorough rinsing, and set them aside to drain.

A convenient method of doing this, is to drive two nails horizontally into the wall or partition, a sufficient distance apart (say about $2\frac{1}{2}$ inches) for the glass to rest on: the upper corner of the glass should be placed against the wall, and the extreme lower diagonal corner left hanging between the nails—which will probably be found the best position for draining yet suggested.

After drying, they may be put into a box for safe and clean keeping. Particular caution is necessary to avoid handling the glass during the operation. I never take the glass between my fingers, so that they come in contact with *both sides* of it, except at one particular corner, as at Figs. A and B. A quantity of glass prepared as above, may be kept on hand for use two or three days, and when wanted they should be again put into the vice* and

* The vice should be thoroughly cleansed, and no particles of rotten stone, or other matter, be allowed to come in contact with the glass, as it might adhere to the edges and wash off into the silvering bath, and ultimately cause specks. *Always remember that cleanliness is an indispensable requisite in order to produce a good picture.*

cleaned, first with cotton flannel wet with alcohol, and then with dry flannel; and then, at a temperature slightly above that of the surrounding atmosphere, except in cases where the thermometer stands above 70° , it is ready for the brush,* which should be carefully applied to each surface, to free it from all particles of dust, and then it is ready for the film of collodion.

The glass is held between the thumb and forefinger of the left hand by the corner 1, Fig. A., 3 and 4 towards

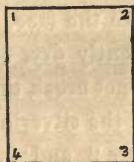


Fig. A.

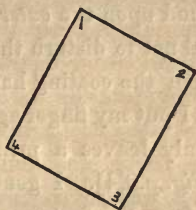


Fig. B.

and nearest the body, and as nearly level as possible. I find this the best position to hold the glass; as, in the case of the larger ones, they can be rested on the end of the little finger, which should be placed as near the edge as possible. Then, from the collodion vial, pour on the collodion, commencing a little beyond the centre and towards 1, continuing pouring in the same place until the collodion nearly reaches the thumb—the glass slightly inclined that way; then let the glass incline towards 4, and continue to pour towards 2.

* One of the most desirable articles I have found for this purpose is the wide (3 inch) flat camel's-hair brush often called a blender.

As soon as enough has been put on to liberally flow the glass, rapidly and steadily raise corner 1, and hold it directly over 3, where the excess will flow off into the mouth of the vial, which should be placed there to receive it. In case of a speck of dust falling at the time of coating, it can often be prevented from injuring the surface by changing the direction of the flowing collodion, so as to stop it in some place where it will not be seen when the picture is finished. Now, with the thumb and finger of the right hand, I wipe off any drops or lines of collodion that may be found upon the *outer* edge or side of the glass, being careful not to disturb that connected with the face.

When the coating has become sufficiently dry, so that when I put my finger against it, it does not break the film, but only leaves a print, I put it into the silvering bath [see Fig. p. 34]. I generally try corners 2 and 3. The time, from the first commencement of pouring on collodion to its being put into the bath, should not exceed about half a minute, at a temperature of 60° . The finger test is the best I have found. The glass is to be rested on a dipper [see Fig. p. 34], and placed steadily and firmly into the nitrate of silver bath—this in a dark room. It should not be allowed to rest for an instant as it is entering the solution, or it would cause a line. The time for the glass to remain in the bath depends upon the age and amount of silver the bath contains; for a new solution, from *two* to *three* minutes will be sufficient to give the proper action. If it be old, three to five minutes will be better. When it is properly coated, it can be raised up and taken by the corner, and allowed to drain for a few seconds, and then should be placed in the tablet, and is ready for the camera. The time of exposure will depend

upon the amount of light present. If the bath is newly mixed, and the collodion recently iodized, it should produce a sufficiently strong impression by an exposure of about one-third of the time required for a daguerreotype. If the collodion has been iodized some time, and the bath is old, about one-half of the time necessary to produce a daguerreian image will be required.

The plate should in no case be allowed to become dry from the time it is taken from the bath up to the time of pouring on the developer. At a temperature of about 70° , I have had the glass out of the bath ten minutes without drying. After exposure, the glass should be taken again into the dark room, and removed from the tablet and held over a sink, pail, or basin and the developing solution poured on it as follows: hold the glass between the thumb and finger of the left hand, by the opposite end corner from that in coating with collodion, *i. e.*, 2, and let 3 and 4 be from you.

Commence pouring on the developing solution at the end by the thumb, and let it flow quickly and evenly over the entire surface, the first flooding washing off any excess of nitrate of silver there may be about the edges or corners of the glass (if this silver is not washed off, it flows over the edges and on the surface of the impression, producing white wavy clouds of scum), and then hold the glass as nearly level as possible, it having upon its surface a thin covering of solution (care should be observed not to pour the developing solution on the plate in *one place*, as it would remove all the nitrate of silver and prevent the development of the image, leaving only a dark or black spot where it is poured on). Put down the bottle containing the developing solution, and take up a quart

pitcher previously filled with water, and as soon as the outline of the image can be plainly seen by the weak or subdued light of an oil or fluid lamp or candle, pour the water over copiously and rapidly. Continue this until all the iron solution has been removed. If this is not done, the plate will be covered with blue scum on the application of the washing solution. Then the glass can be taken into a light room, and the iodide of silver coating washed off with the cyanide solution, and then rinsed with clear pure water, and stood in a position to drain and dry. I place a little blotting paper under them : it aids in absorbing the water, and facilitates the operation.

Place the face of the glass against the wall, in order to prevent dust from falling upon it. I have often dried the coating by holding or standing the glass adjacent to a stove. A steady heat is advisable, as it leaves the surface in a more perfect state, and free from any scum. After the coating is perfectly dry, it is ready for the preserving process. It should be warmed evenly, and when about milk warm, "Humphrey's Collodion Gilding" is poured on the image in precisely the same manner as the collodion. In a few seconds the coating sets, and after three-quarters of a minute, if it has not become dry, the blaze of a spirit lamp may be applied to the back and it will immediately become *perfectly transparent*, and nearly as hard as the glass itself: the effect is fully equal, if not superior, to that of chloride of gold in gilding the daguerreotype image. The surface becomes brilliant and permanent. The back of the glass can now be wiped and cleaned with paper or cloth, and gently warmed, and then with a common small brush one coat of black varnish can be applied. This brush should be drawn from side to side

across the glass, and on the side opposite to that which has received the image.

This is in order not to make streaks in the coating of varnish, but to have uniform lines across the entire length or breadth of the glass. If the varnish is of the proper consistency, it will flow into a smooth, even coating. After this first coating is dry, apply a second in the same manner, only in an opposite direction, so as to cross the lines of the first, uniting at right angles; when this last coating is *very* nearly dry, a piece of paper, glazed black on one side, and cut to the proper size, can be put next the varnish; it gives it a clean finish, at the same time that it aids towards a dense blackening.

I sometimes apply the black varnish by flowing, in the same manner as in putting on the collodion.

This picture is to be colored and put up in the same manner as the daguerreotype image, with a mat and glass. The last glass may be dispensed with by first using the collodion gilding, and then upon its surface apply the black varnish, as before. In this case the image is seen through the same glass it is on, and without being reversed: in this case the mat goes on the outside of the glass.

When the image is seen through the glass upon which it is taken, it cannot be colored with very great success, as it cannot be seen through the reduced silver forming it. This forms a more or less opaque surface; but in point of economy the single glass is preferable. Yet I would not recommend such economy, for I consider that a good impression ought to be well put up, and the welfare of the art fully substantiates that consideration.

Many ways have been devised for putting up pictures I have produced pleasing effects upon *colored glasses*: for

instance, a picture on a light purple glass has a very pleasing effect; also in some other colors. I have also used patent leather for backing the image.

I have produced curious and interesting results by placing a piece of white paper, or coloring white the back of the *whites* of the image, and then blackening over or around this. By this means the whites are preserved very clear.

Positives for Pins, Locketts, etc.—I employ *mica* for floating the collodion on, as it can be as easily cut and fitted as the metallic plate in the daguerreotype; and positives taken upon fine, clear, transparent mica, are fully equal to those taken upon glass, and yet they are ambrotypes.

Mica is an article familiar to every one, as being used in stoves, gratings, etc.

The method of using it, is to take the impression on a thick piece, and then split it off, which can readily be done in the most perfect, thin, transparent plates; it is equally as thin as tissue paper, and can be cut as easily. The thickness of the piece upon which the impression is taken is of no moment, since it can be reduced at pleasure and is more easily handled while thick.

OBSERVATIONS ON THE POSITIVE COLLODION PROCESS.

FOGGING—There are numerous causes which will produce fogging: the principal ones will be mentioned. One is the admission of light upon the collodion. This may be from a want of closeness of the dark room, the tablet,* the camera, or by accidental exposure. The method to locate the particular cause is to, *first*, when the glass is

* Since the foregoing pages have been in type an entirely new feature in the line of apparatus has been introduced; this is W. & W. H. Lewis's Patent Plate-holder with solid glass corners. These Holders have every requisite for excluding the light from the sensitive surface; they are accompanied with a "shut off," so that when the slide is drawn no light can reach the glass. This, in connection with the unequalled advantage of the solid corners, makes them the most desirable article for the Operator. *Humphrey's Journal*, in referring to these Holders, says:—

"We are always glad to note every step which our mechanics make towards improvement on the apparatus used by our practical photographic operators, and make the present announcement of one which has only to be known to be readily understood, and to be seen to be appreciated. A patent has recently been granted for making *solid glass corners*, which are to be attached to plate-holders, and form the most perfect article that has ever been introduced. Heretofore the operator has had the corners of his plate-holders made with separate pieces of glass, cut so as to fit the corners of his frames; these are only glued or grooved in, and are constantly coming apart, falling out, and annoying in many ways; for our part, we never have considered them as fit for use in any manner. We look upon the present improvement as destined to entirely supersede all the methods heretofore introduced. In this case the collodionized or albumenized plate can come in contact with no other substance than a single piece of glass, and consequently there is far less liability of accident from either the staining of the plate or breaking of the holder. The rapid favor this improvement has gained already shows its great advantage over all other methods heretofore employed."

taken from the nitrate bath, let it stand for sufficient time to drain, then pour on the developer, and if the coating assumes a mistiness, or light-grey color, the fault is in the dark room ; again, if the plate, after it has been treated with the developer and fixed, is clear, then also the fault is there. Now try the tablet in the same manner, and if not there, try the camera, and the proper location will be found.

“Decomposition by exposure to light or by long keeping, even in the dark. The author conceives that it is possible for organic matter alone to produce, after a time, a partial decomposition of solution of nitrate of silver, sufficient to prevent it from being employed chemically neutral, but probably not much interfering with its properties in other respects.

“Use of rain water or of water containing carbonate of silver being perfectly neutral and from nitric acid. This difficulty is not a theoretical one only, but has actually been experienced. Rain water usually contains ammonia, and has a faint alkaline reaction. Pump water often abounds with carbonate of lime, much of which, but not the whole, is deposited on boiling. To remove the alkaline condition, add acetic acid, one drop to half a pint of the solution.

“Partial decomposition of the bath, by contact with metallic iron, with hyposulphite of soda, or with any developing agent, even in small quantity. Also by the use of accelerators, which injure the bath by degrees, and eventually prevent its employment in an accurately neutral state.

“Vapor of ammonia, or hydrosulphate of ammonia, escaping into the developing room.”

SPOTS.—One principal cause of spots is *dust*. The operating room should be kept as free from this as possible, and instead of its being dusted, it should be wiped with a damp cloth. Specks or flakes of iodide of silver are often found in the nitrate bath. These sometimes occur by an over-iodized collodion, and sometimes by collodion falling off while being silvered. When this occurs, the nitrate of silver solution should be filtered. A new sponge or a tuft of cotton is a good article to filter nitrate of silver solution through. A small particle of light finding its way upon the plate, will produce a spot. Another and very frequent cause is, putting the slide of the tablet down rapidly, causing it to spatter upon the plate the solution which has drained off from it. This paper will be opaque when viewed by reflected light, and dark when viewed by transmitted light. Occasionally a sort of transparent spot will appear: this may be traced to a want of sensibility of the iodide of silver. Large transparent spots frequently appear by the operator's pouring the developing solution upon one place, and *washing* off the small quantity of nitrate of silver necessary to develop the image. This will be easily detected, and can be obviated by *flooding* the most of the surface of the glass with a steady stream of the developer.

STAINS AND LINES.—If the glass be allowed to rest for an instant with one portion of its surface in the silvering solution and the other out of it, it would cause a streak across; hence the necessity of totally immersing it with one firm, steady motion removing the glass before it has been thoroughly wetted, and the ether and alcohol allowed a uniform action over the entire surface. A plate should

not be disturbed in the bath until it has been in a full minute at least.

Irregular Lines are often caused by using the developing solution too strong, or by not pouring it evenly over the plate at once. Should it be allowed to rest in its progress, if but for an instant, it will leave its line. Sometimes spangles of metallic silver appear : these are caused by the presence of too much nitric acid in the developer for the proportion of iodide in the film and the strength of the bath.

There are other phases connected with the practice of the positive process, which it would be almost impossible to commit to paper, and cannot be so explained as to be perfectly comprehended by the new experimenter. It is absolutely necessary for all to observe every little point noticed in the foregoing pages, and at the same time exercise some good judgment, and no one need hesitate through fear of not being successful.

PRACTICAL DETAILS
OF THE
NEGATIVE PROCESS.

NEGATIVE 130088

CHAPTER V.

NEGATIVE PROCESS—SOLUBLE COTTON—PLAIN COLLODION
—DEVELOPING SOLUTION—RE-DEVELOPING SOLUTION—
FIXING THE IMAGE—FINISHING THE IMAGE—NITRATE
OF SILVER BATH.

NEGATIVE PROCESS.

The manipulations and chemicals employed in the production of the negative collodion pictures are very similar to those already given for operating by the positive process; frequent reference will therefore necessarily be made to portions of that process, as described in the preceding pages, and only such parts will be given here, as do not correspond with the foregoing.

It is thought advisable to omit in this chapter every reference that does not have a desired tendency to aid the operator in the plain straightforward order of manipulation. The negative process is fast becoming popular and needs the attention of all who desire to keep pace with the experiments in the art. Since the first edition of this work it has been my pleasure to see many fine photographic specimens produced by the following process, and no

one need fail, if he will carefully adhere to the details given.

There perhaps may be circumstances making it advisable for some to have but one nitrate of silver solution for both positive and negative collodion pictures: for such, a process will be given in the following pages, which has recently appeared in *Humphrey's Journal*, and is called, after its author, the "Helio Process," this is well adapted for most purposes.

SOLUBLE COTTON.

The method for preparing this has been given in page 41. It is prepared in the same manner for both positives and negatives.

PLAIN COLLODION.

The preparation of plain collodion employed is the same as that described at page 53.

DEVELOPING SOLUTION FOR NEGATIVES.

Rain or distilled water	-	-	-	-	-	-	6 ounces
Proto-sulphate of iron	-	-	-	-	-	-	300 grains.
Acetic acid	-	-	-	-	-	-	2 ounces.

A little alcohol may be added to make it flow more evenly over the plate—say 1 oz.

This solution can be kept in a pint bottle, and should have a funnel devoted solely to the purpose of filtering it. One of the most convenient dishes for receiving this solution, when poured over the plate, is a bowl with a lip to it, as it can be readily poured back into the funnel.

The mode of employing this developer is the same as that for positives, described at page 133. It may be used an indefinite number of times, but should be kept clean ; it soon assumes a red color.

RE-DEVELOPING SOLUTION.

This solution is for the purpose of giving increased intensity to the negative, but as its use in the hands of beginners is attended with some difficulty, I would not recommend the operator to try it until he has had considerable experience in the developing process, or he will undoubtedly spoil his proofs. Its use requires promptness of action and quick observation.

The following is the formula for its preparation :

Water	-	-	-	-	-	-	-	-	4 ounces.
Protosulphite of iron	-	-	-	-	-	-	-	-	400 grains.

Put this into a bottle, and when the crystals are dissolved, it is ready for use. It should be kept filtered, and can be used only once. Now in another bottle put

Water	-	-	-	-	-	-	-	-	4 ounces.
Nitrate of silver	-	-	-	-	-	-	-	-	48 grains.

REMARKS.—The impression is to be well washed after the developing solution has been poured off, and then the *redeveloping solution* (that portion containing the proto-sulphate of iron) can be poured on—the plate being held perfectly level : the surface is completely covered ; the water containing the nitrate of silver should then be poured *rapidly* on, to mix with the iron, when the surface of the impression will instantly commence to blacken ; and if the

action be allowed to continue for a lengthened period, say one minute, the impression will be ruined.

It is a matter worthy of notice, that there is no perceptible action when the iron solution is poured over the glass; but the action is very energetic the instant the nitrate of silver solution comes in contact with the iron salt and the silver.

As soon as any change can be observed, after the re-developer has been poured over the plate, it should be *quickly* and copiously washed off with clean water, and then it is ready for the fixing process.

I would dissuade novices in the art from practising with the *re-developing solution*, until they have first thoroughly mastered the entire process of taking negatives. The developing solution is the only one used by operators generally, and will, with proper care, produce satisfactory results.

FIXING THE IMAGE.

Water	-	-	-	-	-	8 ounces.
Hyposulphite of soda	-	-	-	-	-	4 ounces.

REMARKS.—This is nearly a saturated solution. The glass can be put in a dish and the solution poured over, or held in the hand, in the same way as the plate in the daguerreotype process. It can readily be seen when a sufficient action has been attained, as the unaltered bromoiodide of silver will be dissolved, leaving only the reduced surface holding the image.

This action should not be continued too long, as it affects the intensity of the picture, injuring it for printing.

The glass should be well washed by pouring over it clean water, and then it can be stood away to dry, in a

nearly perpendicular position, on clean blotting paper, or otherwise, as is most convenient; when thoroughly dry, it is ready for the finishing.

FINISHING THE IMAGE.

This is done with the same material, and in the same manner, as that given for positives—page 134.

REMARKS.—The glass negatives, when not wanted for use, should be carefully put aside in a box, and kept free from dust and dampness: by so doing, it is believed that they will remain good for any length of time.

NITRATE OF SILVER BATH.

This solution differs only from the positive bath, by omitting the *nitric acid*: in all other respects it is precisely the same, and is prepared by the same formula, as given at page 64.

This is called the *neutral bath*, and is best adapted to the negative process. The nitrate of silver employed in its preparation should be perfectly free from excess of nitric acid, otherwise the whole solution will be slightly acid.

If it should not be convenient to obtain nitrate of silver without this objection, the acid may be neutralized by putting into the solution a small quantity of common washing soda—say 1 grain to each 100 grains of nitrate of silver—previously dissolved in about half an ounce of water. This may be put in at the same time that the iodide of potassium is, and it would save one filtration.

In twenty samples of nitrate of silver that I have tried

the above quantity of soda has been found sufficient ; if, however, the *white* precipitate first formed is re-dissolved on shaking the mixture, free nitric acid is present, and more of the soda may be added.

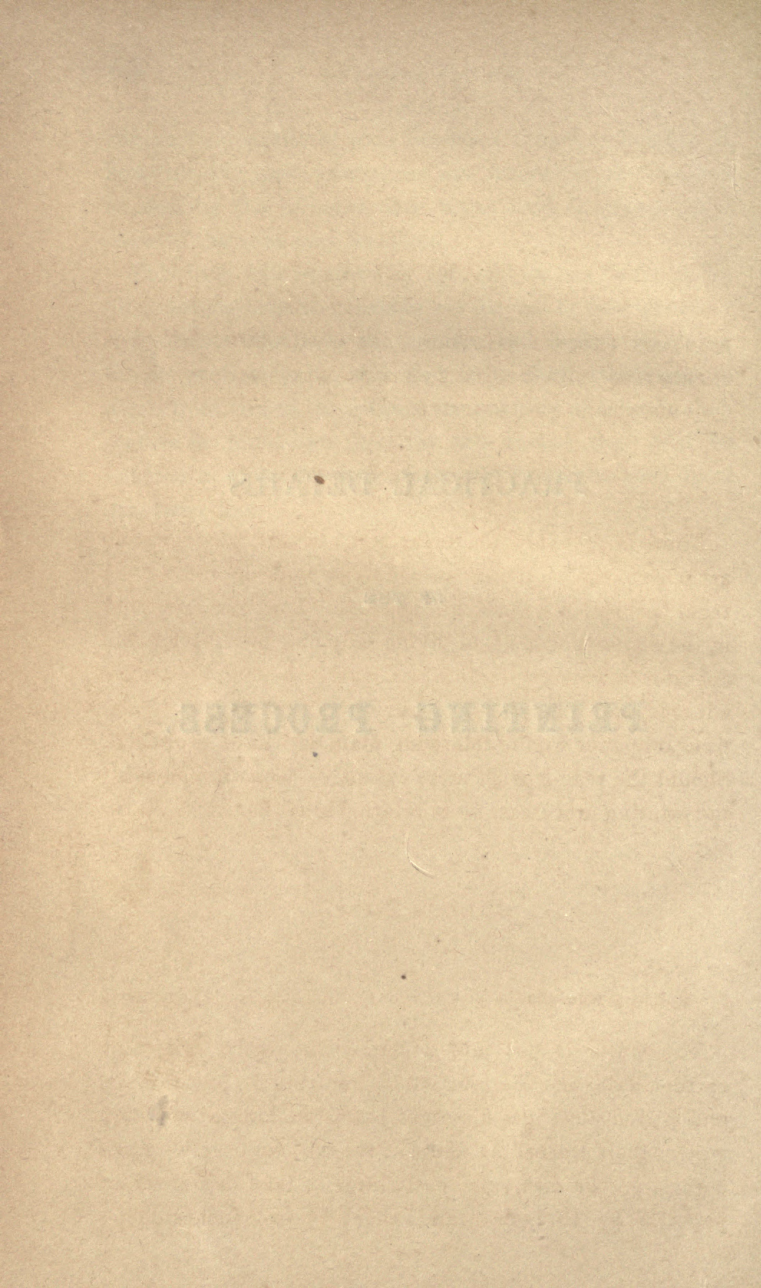
This bath will improve by age, and be less liable to fog after having been in constant use for one or two weeks.

Operators who have the means, and design following the art professionally, will find it to their advantage to make from two to three times the quantity of solution they require for immediate use : by this means they will be enabled to replenish their stock, which may be used up or otherwise lost.

PRACTICAL DETAILS

OF THE

PRINTING PROCESS.



CHAPTER VI.

PRINTING PROCESS—SALTING PAPER—SILVERING PAPER—
PRINTING THE POSITIVE—FIXING AND COLORING BATH
—MOUNTING THE POSITIVE.

THE PRINTING PROCESS.

There is probably no department of the photographic art where can be found an equal amount of variety, as regards chemicals, manipulations, etc. The course adopted in the commencement, of giving only one process for the operator to work by—and that a good one—will be strictly adhered to in this place. I have produced as good positives on paper by the following plan, as I have ever seen. Should the reader wish more extensive acquaintance with the printing processes, he is referred to HUMPHREY'S JOURNAL.

SALTING PAPER.

Water	-	-	-	-	-	-	-	-	1 quart.
Muriate of ammonia	-	-	-	-	-	-	-	-	65 grains.

The water is put into a flat, gutta-percha, glass, or earthen dish, and the muriate of ammonia is put into it, and stirred until it is dissolved and is well mixed with the water; then proceed as follows: we will suppose we have a gutta-percha dish sufficiently large to take in a sheet of paper 8 by 10 inches, and about $1\frac{1}{2}$ or 2 inches deep:

take hold of two corners of the paper with the thumb and finger of each hand, and then draw the paper through the solution, by passing it from one end of the dish to the other, so that it will be wetted on both sides; then turning it over in the same manner, draw it back, so that its surface will be thoroughly moistened, but it is not necessary to *saturate* the paper. Now the paper is ready for drying, which may be done by hanging it on the edge of a shelf by means of little tack nails put through it at the same corners by which it was held in passing through the salting solution. In order to prevent streaks, from forming upon the paper, it is better to hang it in such a manner that it cannot touch the shelf, except at the corners: say the sheet is eight inches wide, and the tacks (which are put through the corners) to be only five or six inches apart, this will give the proper bend outwards, preventing its contact with the shelf. This entire operation can be performed in daylight, or otherwise as suits the convenience of the operator.

This paper, when dry, should be laid between the folds of blotting paper (filtering paper will answer), and may be kept for any length of time, and is ready for the silvering process.

SILVERING PAPER.

In silvering paper, I employ the ammonio-nitrate, which is prepared as follows:—

Water	-	-	-	-	-	-	-	2½ ounces.
Nitrate of silver	-	-	-	-	-	-	-	75 grains.

Dissolve (in a 4-ounce vial) the nitrate of silver in the water, and then pour one-fourth of the solution into an

ounce graduate or any convenient vessel: this keep for farther use in preventing the presence of an excess of ammonia. Now, into the bottle containing the three-fourths put about 4 drops of aqua-ammonia; shake well and a brown precipitate will be given. Continue adding the ammonia, *drop by drop*, and shake after each addition, until the brown precipitate is re-dissolved and the solution is clear; then pour back into the bottle the one-fourth taken out at first: this will leave the solution slightly turbid, and when so, there is no excess of ammonia which would be objectionable. It may now be filtered through filtering paper, and it (the clear liquid) is ready for use. This should be kept in the dark, as it decomposes rapidly when exposed to light.

The method of silvering the paper with ammonio-nitrate of silver, is as follows: take a tuft of clean cotton, roll it into a ball-shape, then wet it by holding it against the mouth of the bottle containing the ammonio-nitrate, and when well wet, apply it to the paper (which should be placed flat on a clean board) by gently rubbing it over the surface, care being taken not to roughen it.

If the solution has not been filtered for some time, it would be advisable to pour a little on the centre of the paper, and then distribute it over the surface by means of the cotton, which is held in the fingers: by this last method any sediment which may be in the bottom of the bottle is prevented from getting upon the paper, and causing spots.

I have used a brush for the purpose of distributing the solution, by which plan there is less liability of getting it on the fingers and staining them. Care must be taken to cover the *entire surface* of the paper, or there will be light streaks, occasioned by the absence of the silvering solution.

This want of silver will appear on the paper in light parts, as seen in the accompanying cut:

Fig. 36.



After the paper has been perfectly coated, or washed with the silvering solution, it should be placed in a perpendicular position to dry. I usually tack the paper on a board of the requisite size, and then stand it on one edge until it has drained and dried. As soon as dry, it is ready for use. This paper will not keep more than twelve hours, therefore the operator should silver in the morning the quantity required for the day. It is imperatively necessary that the silvered paper be kept in the dark. It is extremely sensitive to light, and a very brief exposure of the prepared sheet would render it unfit for use.

PRINTING THE POSITIVE.

The several kinds of apparatus used for holding the negative and the sensitive paper together, have already been given on page 36, Figs. 31, 32, 33. The paper having been salted and silvered, as just described, should be placed on the pad of the printing frame or glasses, with its sensitive surface up, and then the negative placed

directly upon and in contact with it; then it is to be fastened together, when it will be ready for exposure to the direct rays of the sun. From 10 to 40 seconds will be found enough to give a sufficiently intense print.

The paper first changes to a slate color, and then to a brown or copper color: when of a dark slate color is about the proper time to take it out and immerse in the toning bath.

FIXING AND COLORING BATH.

I have employed the proportions given by Mr. HARDWICH in his *Photographic Chemistry*, page 209—Humphrey's American edition.

Solution of chloride of gold, a quantity equivalent to	-	4	grains.
Nitrate of silver	- - - - -	30	"
Hyposulphite of soda	- - - - -	2	ounces.
Water	- - - - -	8	"

"Dissolve the hyposulphite of soda in four ounces of the water, the chloride of gold in three ounces, the nitrate of silver in the remaining ounce; then pour the diluted chloride by degrees into the hyposulphite, stirring meanwhile with a glass rod; and afterwards the nitrate of silver in the same way. This order of mixing the solution is to be strictly observed; if it were reversed, the hyposulphite of soda being added to the chloride of gold, the result would be the reduction of metallic gold. The difference depends upon the fact that the hyposulphite of gold which is formed is an exceedingly unstable substance, and cannot exist in contact with unaltered chloride of gold. It is necessary that it should be dissolved by hyposulphite of

soda *immediately* on its formation, and so rendered more permanent by conversion into a double salt of soda and gold.

“The *time of coloration* depends much upon the quantity of gold present, and may in some cases be extended to many hours. The results of a few experiments, performed roughly, appeared to indicate that the activity of this bath is less affected by depression of temperature than those prepared with tetrathionate. Certainly the injurious effects of prolonged immersion are not so evident as with the first two formulæ: the purity of the whites remains unaltered for many hours if the bath is new, but with an old bath there is a tendency to yellowness, which is probably caused by the presence of sulphuretted hydrogen. Fresh chloride of gold must be added from time to time, as it appears to be required.”

After the impression has remained in the toning bath a sufficient length of time, it should be placed in a dish or sink of clean water, which should be changed several times—floating for at least 12 hours; then it may be taken out and hung up to dry.

“TOUCHING.”—The *coloring* of a photograph forms no part of my process: this is a matter to be given into the hands of an artist, and when it bears the finishing touch of his skill, it is no longer a *photograph*, but an *oil or water-color painting*; all the delicate workings of nature having been lost or hidden under the colors.

A photograph may often be “touched” to advantage. If, as is frequently the case, there be little white spots on the face of the paper, they may be readily covered by the application of a little India ink, with the point of a wet pencil or fine small brush.

MOUNTING OF POSITIVES.

This, though a small matter in itself, is worthy of great attention. The durability of the proof depends much upon the purity of the paste used in causing its adhesion to the Bristol board. I have employed the following composition with the most eminent success :—

Gum arabic	-	-	.	.	-	-	-	-	2 ounces.
Gum tragacanth	-	-	.	.	-	-	-	-	1½ "
Isinglass	-	-	-	-	.	-	-	-	1½ "
Sugar	-	-	.	-	.	-	-	-	½ "
Water	-	-	.	.	-	-	-	-	3 pints. $\frac{3}{4}$

These ingredients should all be dissolved, and then boiled down to the proper consistency, by means of a gentle heat.

I will give another composition, which will serve a good purpose, and keep for a long time :—

Water	-	-	-	-	-	-	-	-	8 ounces.
One table spoonful of wheat flour	-	-	.	.	-	-	-	-	
Powdered alum	-	-	.	-	-	-	-	-	40 grains.
Powdered resin	-	-	-	-	-	-	-	-	"
Brown sugar	-	-	-	-	-	-	-	-	¼ ounce.
Bi-chloride of mercury	-	-	.	-	-	-	-	-	20 grains.

This last composition may be more convenient for operators, and it will answer the purpose well. It is thought by some to be the *best* and *most durable* paste yet prepared for the purpose.

FACTS WORTH MENTIONING.

The Poisonous Effects of cyanide of potassium upon sores, may be obviated by immediately applying some of the positive developing solution, described at page 62. By this means much annoyance may be avoided to persons afflicted with chapped or sore hands.

Bending Glass Rods or tubes can be easily done by subjecting them to the blaze of a spirit lamp—the same as that used for gilding the daguerreotype. First hold the rod just above the blaze, then gradually allow it to descend into it, imparting to the rod a rotatory motion with the finger and thumb : this will soon cause a softening of the glass, when it may be bent to any desired shape. If the ends are to be bent to form hooks, another small piece of glass, or any *warm* metal, may be placed upon the end, in the blaze of the lamp, and as soon as thoroughly softened, it can be pressed or bent to form the hook. By filing around a glass tube or rod, it may be easily and safely broken at the desired point, by giving it a sudden jerk between both hands, holding it close to the encircled part.

Cementing Glass may be readily accomplished by placing the two ends together in the blaze of the lamp, and holding them there until they attain a sufficient degree of heat to slightly fuse : when cool, the ends will be found perfectly united.

The Background best adapted to positives is unbleached muslin, such as is sold for sheeting, and can be found in almost any dry goods' store: it should be from two to three yards wide. A clouded appearance is given to the background by merely marking it with *charcoal*, forming streaks or "*waves*," resembling clouds. These come out black, or dark, in the positive, and give a variegated appearance. The roughness of the marking does not matter, since the background is generally a little out of the focus of the lenses. Trees and other designs may be represented in this matter.

Positive Collodion Pictures may be whitened by the use of bichloride of mercury, thirty grains to one ounce of water. After the picture has been developed, fixed and washed, by the process given in the preceding pages, the solution of bichloride of mercury may be poured over the surface of the image: it almost immediately presents a series of interesting changes in color. The surface at first blackens but for a few minutes, when it begins to get lighter, and gradually brightens to a pure white, inclining to a blue. It should then be thoroughly washed and dried, as usual.

Instantaneous Pictures may be taken by employing the *iodide of iron* in the collodion. The best method with which I am acquainted, is to have a saturated solution of iodide of iron in alcohol, and drop one or two drops into an ounce of the collodion (which has been previously iodized) used in taking positives. This can be used at once, as soon as mixed. No more of this collodion should be prepared than is wanted for immediate use, as it will keep good for only a few hours. The saturated solution of

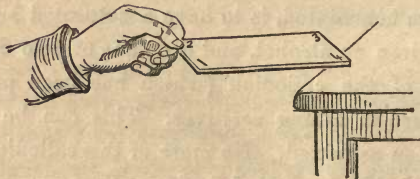
iodide of iron can be kept on hand ready for use at all times. There should be an excess of the iodide in the alcohol. The same accelerating effect is produced with the negative collodion prepared in this way.

Plain Collodion may be iodized as soon as dissolved : this will save time in settling. It is a fact that some cotton is more readily dissolved when the bromo-iodizing is present : but by the addition of this, I have often taken up considerable quantities of the gummy sediment remaining in the bottom of bottles.

Prepared Glass may be preserved clean and free from dust by keeping in boxes such as those used for keeping daguerreotype plates. By taking out every other partition between the grooves, the glass can be readily put in.

Collodion Vials and Bottles, after having collodion in them once, should be rinsed with alcohol and ether (in the same proportions as employed for dissolving the cotton), before using them a second time for that purpose. Penuriousness in this respect would be bad policy.

Coating Large Glasses.—A convenient method of doing this is represented in the following illustration :



The glass is held by one corner, 2 ; the other corner, 4, is

rested on a table or bench, and the collodion poured on, so that the excess may be poured off at 1.

Black Stains upon the hands, caused by nitrate of silver, may be removed by moistening them and rubbing with a lump of cyanuret of potassium. This salt is poisonous, if used to a great extent [*See page 139*]. Another safer, but more expensive plan, however, is to take a saturated solution of iodide of potassium in water, and then wash with nitric acid diluted with two parts water.

Stains upon White Linen can be removed by washing with a saturated solution of iodide of potassium containing a little iodine; then wash with water, and soak in a saturated solution of hyposulphite of soda until the yellow iodide of silver is dissolved.

The hands should always be washed after fixing a positive or negative picture, before again touching a glass to be coated, or the dipper; this precaution is necessary, lest any of the iron salt, or the hyposulphite, should get into the silvering solution and spoil it.

In taking Collodion Pictures, it is always advisable for the sitter to be arranged before the glass is taken from the bath: this will save time and there will be less liability of the collodion drying.

A Good Negative may be known by its possessing the following characteristics:—By transmitted light the figure is bright, and appears to stand out from the glass; the dark shadows are clear, without any misty deposit of metallic silver; the high lights black almost to complete opacity.

A Glass Coated with Collodion, if kept too long before immersion in the bath, will not be equally sensitive over its surface; the parts most dry being the least sensitive.

Glass Pans, for Scales, can be procured by every one at trifling expense: Take a watch crystal, and place in the common metal pan; balance this with lead, or any weight: this can easily be kept clean, and is the most advisable for weighing all deliquescent salts, and chemicals employed in the collodion process.

Caution.—Persons engaged in making collodion, and using ether and alcohol, must bear in mind that these chemicals are *very inflammable*; hence extreme caution is necessary to avoid exposing them to the flame of a lamp or candle. I have known of several serious accidents, of recent date, all of which were caused by the imprudence of the experimenter in the particular above mentioned.

Wipe the Plate-holder every time before the glass is put into it: this will prevent spots, which might otherwise occur from the presence of nitrate of silver solution which drained from the plate previously used. These spots are of an opaque yellowish tinge, and in shape resemble the stain which would be occasioned by a *splash* of water.

Glass for Positives.—A good *white* or light-green glass will answer for the collodion coating. Glass which contains air-spots can be used, if it be placed in such a manner as to let the light of the image come over them, as the spots cannot be seen through the opaque surface. Only the best white glass should be used for *covering* the picture. Some operators use the convex glass, which is very clear, and answers the purpose.

The Nitrate of Silver Bath should be kept covered, except when in use.

If a Glass be Immersed too soon, streaks and waves will be occasioned. These will be seen at the end of the plate which is least dry: the coating is also more liable to peel off. It should be borne in mind, however, that the peeling of collodion is not always attributable to this cause.

Diffused Light in the Developing Room.—In proportion as the sensitiveness of the plates increases, greater care must be exercised in thoroughly excluding all rays of white light. With opalescent films, neutral, this cause of fogging is more common than any other.

In the case of a portrait, if the features have an unnaturally black and gloomy appearance, the dark portions of the drapery, &c., being invisible, the picture has been *under-exposed* in the camera.

CHAPTER VII.

HELIO PROCESS.*

AN ENTIRE PROCESS FOR PRODUCING COLLODION POSITIVES AND NEGATIVES WITH ONE BATH, AND IN MUCH LESS TIME THAN BY ANY OTHER KNOWN PROCESS.—BY HELIO.—PHOTOGRAPHIC PATENTS.

Boston, Oct., 1856.

S. D. HUMPHREY.

Sir,—As Humphrey's Journal is the only truly progressive and independent Photographic publication in America, I feel it the duty of every one to aid its Editor in furthering the interest of the amateur and practitioner of the art; and, suiting the action to the word, I present the following Process as being worthy of confidence, and having, in my hands, proved eminently satisfactory. I am surprised to see that Operators and men respectably connected with the practice of the Art should so far fall beneath the station of true artists as to advertise to catch each other, or the verdant ones, by offering this or that little improvement all “printed complete for five dollars.” As an amateur, and having the good of the science I love at heart, I now contribute my mite for the benefit of all

* It has been thought advisable to publish in this work the *Helio Process*, and I do so just as it appeared in *Humphrey's Journal*.—S. D. H.

interested ; and, following the glorious example of G. B. C. (who I hope we shall soon hear from again,) in your last, I say—God speed !

I shall endeavor to be as minute and concise as possible, so as to enable any one to adopt and successfully use my processes.

Preparation of Soluble Cotton.—I put into a wedgewood mortar, twelve ounces, by weight, of dry and finely pulverized nitrate of potash (I use Dupont's refined), and add to it twelve ounces, by measure, of good commercial sulphuric acid ; I mix these well together by the use of a glass rod and pestel, so that it forms a paste ; I then add, in small quantities at a time, about 325 grains of good coarse cotton (this is according to your process), and *knead* the mass well for from three to five minutes ; and then cover the mortar with a piece of glass, and let it stand for twenty or thirty minutes, by which time it will have been sufficiently acted upon. Then the cotton is to be plunged into a quantity of clean water and thoroughly washed in a number of changes of water, so that when it is squeezed between the folds of blue litmus-paper it will not redden it ; this indicates that the acid has been washed out ; I then place the cotton in a clean strong towel and wring out all the water I can, then put it into alcohol, then wring it again, and adopt your plan of not letting it become thoroughly dry.

The cotton being now ready for use, I dissolve it in the following mixture, in a bottle of proper size :—

Sulphuric ether	-	-	-	-	-	-	-	10 ounces.
Alcohol, 95 per cent.	-	-	-	-	-	-	-	5 ounces.
Soluble cotton, enough to make it about as thick as cream.								

The above should be *well shaken*, and then allowed to

stand for one or two days to settle. This constitutes my Plain Collodion, and should be poured off into another bottle, leaving the sediment behind.

Iodizing.—For this purpose I employ the following preparation:—

A.—Iodide of Silver.—Dissolve fifty grains of nitrate of silver, crystals, in two ounces of pure water, and forty grains of iodide of ammonium in two ounces of pure water; then pour the two together, shaking the mixture well; let it settle, which it will do in a few minutes; then pour off the water carefully, leaving behind all the yellow iodide of silver; pour again a fresh quantity of water over the precipitate, and continue this washing for at least six changes of water; then drain off the water as close as possible and pour on two ounces of alcohol, which, when drained off, will leave the powder sufficiently clean for the purpose.

B.—I now dissolve forty grains of bromide of ammonium and one hundred grains of iodide of ammonium in two ounces of 95 per cent. alcohol, and then add the iodide of silver (preparation *A*), and shake the whole well together, giving a saturated solution. This is to be filtered through cotton or paper, when it will be ready for use.

C.—To sixteen ounces of Plain Collodion add from eight to twelve drops of tincture of iodine (50 grains of dry iodine dissolved in half an oz. of alcohol) and 14 grains or drops of fluoride of ammonium; shake the mixture well; then add all of the solution *B*; shake it again and thoroughly; after this has stood for twenty-four hours it can be used, but will be found better after it has been prepared one week.

Nitrate of Silver Solution.

Pure rain or distilled water	- - - - -	32 ounces.
Nitrate of silver (in crystals)	- - - - -	4½ ounces.
Clean pure white sugar	- - - - -	75 grains.
Six grains of iodide of ammonium dissolved in half a drachm of alcohol.		

The above, thoroughly mixed and allowed to stand for a few hours, should be filtered through a new clean sponge, asbestos, or Swedish filtering paper, and then a few drops of nitric acid, chemically pure, should be added, just enough to redden blue litmus-paper; then it is ready for use, and will improve by age.

Developing Solution.—This formula has proved very satisfactory in my hands, and I hope will be equally so with all who give it a trial:—

Water	- - - - -	1 pint.
Boracic acid	- - - - -	¾ ounce.
Proto-sulphate of iron	- - - - -	¾ ounce.
Pulverized nitre	- - - - -	½ ounce
Three drops of oil of cinnamon dissolved in two ounces of alcohol.		

Dissolve and filter, and it is ready for use. It is better to make this developer fresh every other day.

Dissolving off the Iodide of Silver.—Water, about half a pint; cyanide of potassium, enough to clear the impression in about thirty seconds—say a quarter of an ounce.

Fixing the Impression.—I use the article well known to every good photographer as Humphrey's Collodion Gilding, and it serves the purpose better than anything that I know of.

Black Varnish.—I generally purchase this from the dealer ; but I have made an article which answered the purpose well, by dissolving pulverized asphaltum in spirits of turpentine. Any of the black varnishes can be improved by the addition of a little bees'-wax to it. It is less liable to crack and gives an improved gloss.

Negative and Printing Processes.—Being myself an amateur, and desiring to study economy and convenience, my attention has been given to the test of numerous plans for avoiding the necessity of two baths and silvering solutions and I feel confident that the amateur will find the following, in connection with the foregoing Positive Process, the best adapted to his wants.

The same bath and solution is used for the negative as for the positive process ; and the time of exposure in the camera should be prolonged a few seconds. I have produced beautiful negatives, in-doors, in *four seconds*, and, out-doors, *instantaneously*. The manipulation, bath, and developing solution are precisely the same as those used in the positive process.

Fixing the Negative.—Place the following mixture in a well-stoppered bottle :

Pure Water	-	-	-	-	-	-	6 ounces.
Aqua ammonia, concentrated	-	-	-	-	-	-	1 ounce.

This solution should be poured on the negative and allowed to remain for about twenty seconds. It should be borne in mind, that the developing solution (same as for positives) should be well washed off the glass before the fixing solution is poured over ; after it has remained on the glass for the time given (20 seconds), the negative can be washed with clean water and dried ; it is then

ready for printing. The iodide of silver is not, as in other processes, dissolved off, but remains on the glass.

It sometimes happens that the negative is not sufficiently intense; this result can be obtained by pouring over the plate the following solution, which should remain for about three-fourths of a minute:

Water	-	-	-	-	-	-	-	8 ounces.
Nitrate of silver	-	-	-	-	-	-	-	28 grains.
Alcohol	-	-	-	-	-	-	-	1 ounce.
Loaf sugar	-	-	-	-	-	-	-	$\frac{1}{2}$ ounce

After this solution is used, I pour over the impression the developing solution, and then wash well with water. This re-developing may be repeated two or three times, and almost any desired intensity obtained.

Printing Process—Salting the Paper.—Boil the following mixture in an earthen vessel until it becomes transparent:—

Distilled water	-	-	-	-	-	-	12 ounces
Muriate of ammonia	-	-	-	-	-	-	240 grains.
Arrow root	-	-	-	-	-	-	112 grains.

After this has been sufficiently boiled, it should be strained through clean linen or cotton cloth (free from soap or other substances), and, when cool, it is ready for coating the paper, which is done by dipping a new clean sponge into it and rubbing it over one side of the paper, giving it a uniform coating; but as it is not desirable to have too much on the paper, it should be rubbed with a clean sponge until nearly dry; it can then be hung up by the corner until thoroughly dry, when it can be put into a portfolio and kept for exciting for use.

Silvering Solution—This solution may be prepared in the light, but must be used in a dark room:—

Distilled water	-	-	-	-	-	-	-	-	1 pint.
Nitrate of silver	-	-	-	-	-	-	-	-	3½ ounces. }

Dissolve and pour into an earthen or gutta-percha dish. Take the paper (cut to the proper size) and *float* it on this solution for about three minutes; care must be observed that there are no air-bubbles between the solution and the paper, for this would cause spots. It now can be hung up to dry, and as soon as dry it may be used. Let me here repeat, that this operation must be conducted in a dark room.

Fixing and Toning Bath.—I find that a better effect is produced if the positive be a little over-printed before being acted upon by the following mixture:—

Distilled water	-	-	-	-	-	-	-	-	8 ounces.
Chloride of sodium	-	-	-	-	-	-	-	-	240 grains.

This solution should be put into a flat dish and the print placed on it, face down, for from one and a-half to three minutes, when it should be taken off and put into the following solution, and allowed to remain there from three quarters of an hour to two hours:—

Distilled water	-	-	-	-	-	-	-	18 ounces.
Hyposulphite of soda	-	-	-	-	-	-	-	3 ounces.
Nitrate of silver	-	-	-	-	-	-	-	60 grains.

The following method should be observed in preparing this last mixture, viz.:—dissolve the three ounces of hyposulphite of soda in *sixteen* ounces of the water and

the sixty grains of nitrate of silver in the remaining two ounces ; then pour the nitrate of silver solution into that containing the hyposulphite of soda, stirring the mixture continually until all is well mixed.

After the print has remained in the toning solution for the specified time, it should be taken out and well washed in several changes of clean water, and dried and mounted in any of the usual ways.

With a few general remarks I will close this, perhaps, too long communication. It should be a point in the practice of every one who desires success in any process, to maintain a strict observance to cleanliness ; this is one point in which most persons fail, and it cannot be too strongly impressed upon the minds of manipulators. It should be understood that the foregoing process is *complete in itself*, and is not to be confounded with any other method. The *collodion* is adapted for the *nitrate of silver bath*, and the *bath* for the *collodion* ; and no one should use other preparations of collodion and silvering solution, except they do so with the full expectation that it will be at the *loss of either or both of the preparations employed*.

Allow me, through the columns of your invaluable Journal, to say to those who may read the foregoing process, that if they find (as I have) my process to prove profitable to them, I shall consider myself amply repaid if they will, through the same medium, contribute to our stock of information by giving an account of their experiments. I feel quite confident that some of the amateurs, with whose reputation I am already acquainted, and of whose private works in photography America has cause to feel proud,—could furnish interesting, useful and valuable information upon this subject. Such men, for

instance, as G. B. C., of Md. (who has already made a good beginning), G. W. D., of the same place, and Mr. C. G., of Pa. Friends and co-laborers, shall we hear from you? I pause for a reply!

I look with interest upon every stroke of the pen from your able correspondent G. M., of Washington, whose specimens of photographic engraving you recently had the kindness to show me. I assure you, it did not a little astonish me to witness the surprising truthfulness with which the details were presented.

HELIO.

CORRESPONDENCE

BETWEEN THE U. S. COMMISSIONER OF PATENTS AND JAMES
A. CUTTING, RELATIVE TO HIS APPLICATIONS FOR LETTERS
PATENT.

United States Patent Office, April 17, 1854.

Sir: Your application for letters patent for an alleged improvement in making photographic pictures, having been submitted to the proper examiner, is rejected. As the use of alcohol to absorb water in hasty desiccation is understood to be commonly practical in most chemical laboratories, no reference is thought necessary for the rejection of the first claim.

Secondly, the mixture of alcohol and ether in unlimited proportions to dissolve gun cotton for photographic purposes, is common. [See Gaudin's Process, "Humphrey's Daguerreian Journal," vol. 4, p. 229.]

Thirdly, collodion with bromide basis, is not new. [See General Remarks on Collodion, by Gaudin, "Photographic Art Journal," 1st Series, vol. 6, p. 348.]

The two articles above referred to are translated from the French, and contain also, it is believed, sufficient to show that the subject of the fourth claim has been anticipated, rendering further reference unnecessary.

Respectfully yours, &c.,

S. F. SHUGERT, Acting Commissioner.

J. A. CUTTING (care of C. G. Page), Washington, D. C.

June 17, 1854.

SIR: In regard to the use of bromide bases with collodion, I am prepared to show that I had it in successful use in the month of April, 1853; and if the circumstances require legal proof of the same, it will be furnished, though at some expense of time and money to me; and as the question is only between the public and myself, I trust the office will see fit to grant me a patent for the same.

JAMES A. CUTTING.

Hon. CHAS. MASON, Commissioner of Patents.

United States Patent Office, April 19, 1854.

SIR: In your letter of the 17th, you say that, if necessary, proof can be given that you had in successful use, in the month of April, 1853, collodion prepared with a bromide basis. On referring to the "Journal of the Photographic Society," of London, No. 6 (June, 1853), page 70, you will see that Sir John Herschel used bromide for the same purpose previous to the year 1840. Ammonia, in various combinations, has long been in use for the preparation of sensitive collodions. [See Report of the British Association, 1850, p. 150, "Journal of the Photographic Society," No. 9, 1853, p. 116.] F. M. Lyndes' process and compositions show that he has used iodine, bromide, and chloride of ammonium; and Count de Montegon, in the same journal, No. 2, April, 1853, page 24, for his fifth composition of collodion, used liquid ammonia. These are all regarded as equivalents for your compositions covered by the fourth claim; if, however, there is a difference, you are at liberty to show in what it consists; and the examination is accordingly postponed to await your action.

Yours, &c.,

C. MASON, Commissioner.

J. A. CUTTING (care of C. G. Page), Washington, D. C.

Washington, June 21, 1854.

SIR: In reply to your communications of the 19th instant, and April 17th, 1854, I propose to modify my claims as follows, to wit:

After the first clause of the claim, nineteenth line, ending with the words "set forth," add as follows: "I do not claim the use of alcohol as a *desiccating agent*, but limit my claim to its special use and purpose, as herein stated."

Erase the fourth clause of the claim, commencing on the twenty-sixth line, and ending with the words "set forth on the thirtieth line."

In reply to the objection raised by the office that "bromide was used in 1840," I have to say that I was fully aware of the employment of bromide in various ways for photographic purposes, and that I have also, in common with photographers, known the extreme difficulty of using bromide, and that notwithstanding the sensitiveness imparted by bromide to other compounds, it has been almost universally discarded by practical photographers. The discovery of collodion as a vehicle for sensitive materials is of recent date, and there seems to have been a backwardness on the part of photographers to attempt bromide bases with collodion, and so far, whatever trials have been made sub-

sequent to my discovery, it is evident that they have been attended with the results of "misty pictures." To whatever my success may be due, I maintain that I have been the first to use a bromide base with collodion—and with that only do I claim it—and the results in my pictures show with what success.

Respectfully,

JAMES A. CUTTING,

By Att'y, CHAS. G. PAGE.

Hon. CHAS. MASON, Commissioner of Patents.

United States Patent Office, June 21, 1854

SIR: Your specification of an improvement in composition for producing photographic pictures is herewith returned for a slight amendment, which is, to omit the reference to specimens which do not accompany the patent. and to correct an error in the oath as noted on the margin.

Yours, &c.,

C. MASON, Commissioner.

JAMES A. CUTTING, 142 Hanover st., Boston, Mass.

United States Patent Office, June 22, 1854.

SIR: By reading a paper by Mr. W. Crookes in the "Journal of the Photographic Society, London," No. 7, p. 86, "on the employment of bromine in collodion," it is believed you will be satisfied that the date there given on which he used bromized collodion is prior to your claim to having used it; he refers to p. 72, No. 6, published in June, 1853, for experiments made with bromized collodion, which paper is dated June 2d, 1853. Mr. Isaac Rhen, of Philadelphia, has testified to having seen you make use of a bromide base, viz., bromide of potassium and collodion, about the 1st of July, 1853, or about one month after the date of Mr. Crookes' paper in England. The specification is accordingly returned, that you may cancel the fourth claim, and amend the papers to suit.

Yours, &c.,

C. MASON, Commissioner.

Mr. J. A. CUTTING, (care of C. G. Page), Washington, D. C.

PATENT FOR THE USE OF CAMPHOR IN COMBINATION WITH
IODIZED COLLODION.

The schedule referred to in the Letters Patent, and making part of the same.

To whom it may concern :

Be it known, that I, JAMES A. CUTTING, of the City of Boston, County of Suffolk, and State of Massachusetts, have invented a new and useful improvement in positive photographic pictures on glass, and I do hereby declare the following to be an exact description thereof :

The nature of my invention consists in the use of gum camphor, in addition to the existing materials in the preparation of collodion for positive photographic pictures on glass.

To enable others skilled in the art to make and use my invention, I will proceed to describe the process as follows :

Having prepared the collodion in the usual manner, I take a pint bottle, in which I introduce twelve ounces of collodion, to which I add one drachm of iodide of potassium, dissolved in alcohol. I then shake the mixture thoroughly, and add thereto eighteen grains of refined gum camphor, shaking the mixture again, until the whole is combined, then allow it to settle, when it is fit for use.

The advantages of my improvement consist in the increased vigor of the delineations of the half-tones of positive pictures on glass, giving greater depth and rotundity thereto, which render this combination exceedingly useful for microscopic pictures, as well as the ordinary purposes of portraiture.

I would have it understood that the combination of camphor with iodide of potassium and collodion, as above specified, is adapted solely to the production of positive pictures on glass and not to the production of negative pictures on glass, from which positive pictures on paper may be printed, as a sufficient degree of opacity is not thus afforded for that purpose.

What I claim as my invention, and desire to secure by Letters Patent, is the use of camphor, in combination with iodized collodion, as set forth in the specification.

JAMES A. CUTTING.

SAMUEL GRUBB, }
I. REHN. } *Witnesses.*

Dated, July 4th, 1854.

PATENT FOR THE USE OF BALSAM FOR SEALING PHOTOGRAPHIC PICTURES ON GLASS.

The schedule referred to in Letters Patent and making part of the same.

To whom it may concern :

Be it known that I, JAMES A. CUTTING, of Boston, in the County of Suffolk and State of Massachusetts, have invented new and useful improvements in photographic pictures on glass, and I do hereby declare the following to be an exact description thereof :

The nature of my improvement consists in the application of a coating of balsam of fir to the side of the glass on which the picture is made, over which coating I place another glass of equal size with the one on which the picture is.

To enable others skilled in the art to make and use my invention, I will proceed to describe the process as follows :

After thoroughly cleaning a glass plate of the same size as that on which the picture to be secured is made, and moving all dust from the picture, I hold the glass containing the picture in a horizontal position with the pictured side uppermost, then apply the balsam in a line along one edge of the glass and placing one edge of the second glass in close contact with the first, containing the balsam, press them gradually together towards the opposite edge, causing the balsam to flow by a gentle pressure towards the opposite edge, in this manner excluding all air from between the glasses ; then by an even pressure exclude the superabundant balsam. The advantages of my improvements are, that by a mechanical combination of the balsam with the picture it is greatly increased in strength and beauty, by an additional brilliancy and the exhibition of the most minute delineations ; and by the application of the second glass in combination with the balsam, the picture is hermetically sealed and rendered entirely permanent, by being secured from the influence of both air and moisture, and also from injury by dust or other extraneous matter, or acid vapors, or any violence less than what could occasion the fracture of the plate glass.

I am aware of the previous use of balsam for the cementing of lenses and the securing of microscopic objects, and other like purposes, and do not therefore extend my claim to any of these uses ; but

What I claim as my invention, and desire to secure by Letters Patent, is the combination of balsam with photographic pictures on glass, and with additional glass by which they, with the balsam, are hermetically sealed, as described in the specifications, and for the purposes therein set forth, and for no other.

JAMES A. CUTTING.

ISAAC REHN, }
SAMUEL GRUBB, } *Witnesses.*

Dated July 11th, 1854.

PATENT FOR DISPLACING WATER FROM SOLUBLE COTTON
BY THE USE OF ALCOHOL ; ALSO, FOR THE USE OF BRO-
MIDE OF POTASSIUM IN COMBINATION WITH COLLODION.

The schedule referred to in these Letters Patent, and making part of the same.

To all to whom these presents shall come :

Be it known that I, JAMES A. CUTTING, of Boston, in the County of Suffolk and State of Massachusetts, have invented certain improvements in making photographic pictures, and that the following is a full, clear and exact description of the principle or character which distinguishes them from all other things before known, and of the usual manner of making, modifying, and using the same.

My improvements relate to that class of photographic pictures in which the pictures are obtained upon a prepared film of glass or other substance.

The film which I employ is collodion, and in order to insure success, the collodion must be prepared after my own process, as follows: Take 3 ounces (Troy) of pure dry nitrate potassa, and pulverize in a clean glass mortar; add to this $2\frac{1}{2}$ ounces, fluid measure, of pure sulphuric acid, and stir the mixture with a glass rod; immerse in this liquid, 80 grains of clean, dry cotton, and knead the mass of cotton in the liquid for about five minutes; remove the cotton and quickly wash it, till every trace of acid is gone, and it must then be dried quickly—for I have discovered that the more rapidly the cotton is dried, the more sensitive the collodion; and I have found the best effects produced by displacing the water from the cotton by strong alcohol.

To prepare the collodion, take 10 ounces concentrated sulphuric ether, 60° Baume, and mix this with 6 ounces of 95 per cent. alcohol. To this mixture add the prepared cotton, in quantity sufficient to make a collodion as thick as it can, and yet at the same time flow evenly over the surface of glass. Let it settle clear, and decant the solution.

In order to "excite" this collodion, take a deep 1 ounce vial—introduce $2\frac{1}{2}$ grains of bromide of potassium, and add water, drop by drop, to make a saturated solution. In this solution dissolve $2\frac{1}{2}$ grains of iodide of potassium, then add 1 ounce of collodion, and shake well. Let it settle clear and decant for use.

The solution must be decanted every day. In order to make the most sensitive collodion, I dissolve the bromide and iodide of potas-

sium and the collodion* in a saturated solution of carbonate of ammonia in water. In using this collodion, pour it upon a clean glass plate to form a film in the usual way, and as soon as the collodion has set, and before it becomes dry, immerse the plate in a bath of nitrate of silver, made with 30 grains of nitrate of silver, 2 grains of iodide of silver, and 1 ounce water. Take the plate directly from the bath to the camera, and after sufficient exposure, the plate is taken to a dark room to develop the impression with the following solution: Take pyrogallic acid, 4 grains; acetic acid, No. 8, 1 ounce; dissolve and filter. For use, take of this liquid $1\frac{1}{2}$ drachms, diluted with $6\frac{1}{2}$ drachms of water, and when the impression is sufficiently developed, pour off the liquid, and immerse the plate in a solution of the hyposulphite of soda, 4 ounces to the pint of water. Wash the plate with pure water, and dry it in the usual way.

The advantages of the above process are, the brief time required to produce an impression, and the sharpness of the pictures. Portraits can be taken with as much facility as with the Daguerreotype, and the pictures are sharp and of excellent tone. The impression thus obtained is negative, and the positive picture is produced in the usual way. I denominate this the mezzographic process.

What I claim as my improvements in the process of obtaining photographic pictures, are—

First. Displacing the water from the cotton, for this purpose, with strong alcohol, as set forth. I do not claim the use of alcohol as a *desiccating agent*, but limit my claim to its special use and purpose, as herein stated.

Second. The employment of bromide of potassium in combination with collodion.

JAMES A. CUTTING.

T. CAMPBELL, }
SAMUEL GRUBB. } *Witnesses.*

Dated July 11th, 1854.

PATENT FOR THE USE OF JAPANNED SURFACES PREVIOUSLY
PREPARED UPON IRON OR OTHER METALLIC OR MINERAL
SHEETS OR PLATES IN THE COLLODION PROCESS.

To all whom it may concern :

Be it known that I, HAMILTON L. SMITH, of Gambier, in the County of Knox, and State of Ohio, have invented certain new and

* This is a mistake: the collodion is not to be dissolved in the "carbonate of ammonia in water," but only the bromide and iodide of potassium. I called Mr. Cutting's attention to this, and he said I was correct.—S. D. H.

useful improvements in Photographic Pictures, and I do hereby declare the following to be a full, clear, and exact description of the same, and of the manner of making and using my invention or discovery.

The nature of my invention or discovery relates to the taking of *positive* pictures by the photographic process, upon a black japanned surface prepared upon iron or any other metallic plates or sheets, and consists in the use of collodion, and a solution of a salt of silver, and an ordinary camera.

To enable others skilled in the art to make and use my invention, I will proceed to describe the manner of preparing and applying it which I have found to answer well in practice; not confining myself, however, to the special process or processes herein described, so long as the characteristics of the invention remain the same.

I first take metallic sheets, preferring for the purpose iron, as this metal is the only one, except the precious metals, which is without action on the silver salts generally used, as also the other chemicals; but other metallic or mineral sheets may be used, and I do not, therefore, confine myself specially to any particular metal. Upon each of the sheets is prepared a black japanned or varnished surface, such as is used by tinners or japanners for coating metallic and other surfaces. The japan or varnish may be made and applied as follows:—Take one quart of raw linseed oil; add to this two ounces of asphaltum and sufficient umber, or lamp black, to give the desired shade. Boil these ingredients until a portion dropped on a cool surface will remain in a round spot without flowing away. It is then thick enough to use. If it should be too thick, it can readily be thinned with spirits of turpentine. Apply the japan to the sheets or plates with a brush, and after allowing it to stand a short time, until the marks of the brush disappear, place the sheets or plates in a drying oven and submit them to heat until the surface will bear the finger to be drawn over it without bringing off the japan; it may, if found necessary, be coated again and treated in a similar way, and finally polished with rotten-stone and oil, or other polishing material. Other ingredients may be used in making the japan, such as mastic, lac or copal varnish, and other shades of coloring matter may be used.

By collodion I mean any solution of gun-cotton or pyroxyline; and by a solution of salt of silver, I mean any of the salts thereof which can be used in photography for obtaining positive impressions by a camera.

A japanned surface may be prepared on glass, or on leather and other fibrous materials. Or glass may be made black by means of

coloring matter introduced or embodied with the glass, so as to be *in* instead of *on* the glass. But foreseeing the difficulty of embracing all these applications in one application, I do not desire to have them so considered; but reserve the right to hereafter apply for such application of my general principle as I may deem essential, or of sufficient importance to be protected by Letters Patent. And it might be proper to add, that vulcanized gutta-percha or indurated rubber may be used as the basis upon which, or in which the japanned surface may be made. The invention, however, consists mainly on the surface, so that a silver picture may be made upon it, said surface forming the back-ground of the picture.

The ingredients for fixing and developing the positive impression upon the japanned surface may be the same as those heretofore essayed by me in a former application, and need not again be repeated here. Though other chemicals, or other proportions of the same chemicals, may be used.

Having thus fully described the nature of my improvement in photographic pictures, and shown how the same may be accomplished, what I claim therein as new and desire to secure by Letters Patent, is:—

The obtaining *positive* impressions upon a japanned surface previously prepared upon an *iron* or other metallic or mineral sheet or plate, by means of collodion and a solution of a salt of silver and a camera, substantially as herein described.

HAMILTON L. SMITH.

GEO. T. CHAPMAN, }
JAMES H. LEE. } *Witnesses.*

Dated February, 19th, 1856.

PHOTOGRAPHIC PICTURES ON OIL.

To all whom it may concern:

Be it known that I, JOEL HAYWOOD TATUM, of the City of Baltimore and State of Maryland, have discovered or invented a new and useful preparation of oil ground or body, and mode of

preparing the same by which Photographic impressions, such as portraits of all sizes, landscapes or still life may be produced upon such oil prepared ground body or surface, whether upon canvass, mill-board, pannel, or other body whatever, without any permanent injury to such body, ground or surface for the reception of colors in oil (water) or dry (paste), without impairing the texture, quality, durability, or other desirable quality of the body ground, or surface rendered so impressible, and give the following as the Process used in accomplishing the result.

I take ordinary prepared canvass, mill-board, pannel or other substance for the reception of oil painting by any composition of oil (or oleaginous substance) and oxide of lead or zinc, Spanish whiting, Fuller's earth, or their equivalents, singly or in combination, and after having removed all irregularities or lumps from the surface I damp or wet the surface with spirits of wine, and wipe clean; after which, I treat the surface with a solution of potassium or any good alkali, regulating the strength to the amount of oil in the body-ground or surface to be treated (ordinarily 1 oz. of super. carb. soda to 1 pint of water), as soon as the surface has uniformly changed color allow the surplus solution to run off, wash off by pouring over the surface clean water, let dry, but not by the fire or in the sun, as that would bring out the oil to the surface. When dry, treat the surface again with a solution of the chloride of sodium (of the strength ordinarily used and prescribed for paper positives), decant from the surface the superfluous fluid after a minute, and let dry, as before; remove to a dark room, and treat the surface with a solution of the nitrate of silver, its strength being governed by the strength of impression desired, usually 18 grains of nitrate of silver to 1 oz. of distilled water; allow the solution to float upon the surface a few moments to insure uniformity of deposit, and then decant the surplus, in the bottle or lath; place a small piece of filtering paper on the edge of the body, and place that, edge down, to facilitate the drainage; when dry, place the negative impression (which must previously have been obtained, by the use of the camera, either on collodion

or albumen upon glass or upon paper) upon the body or ground to receive the impression in the position the picture is desired, with the face of the negative to the surface of the body to receive the impression. If the negative impression does not cover the whole surface, then a mat should be used so as to extend to the edge of the ground on all sides. Expose to the light, and, when sufficiently long, remove the negative into a dark room (lighted with a feeble lamp); dash over the impression a weak solution of hyposulphite of soda, and let stand a few moments; then wash off with a very dilute acid of only sufficient strength to neutralize the alkalies remaining upon the surface, usually five or six drops of sulphuric acid to an oz. of water is sufficient.

What I claim as my own invention and discovery, and desire to secure by Letters Patent, is the mode of preparing and rendering oil (oroleaginous) bodies, grounds, or surfaces impressible or sensitive to the Photographic art by the temporary destruction or chemical change of the oil or oleaginous matter of the immediate surface only, by the use of spirits of wine and alkaline solution, or their equivalents, and, after fixing the impression by the use of hyposulphate of soda, the use of dilute acid, by which last application the alkalies are neutralized and the oil restored with the impression permanent upon the surface.

Disclaiming everything heretofore known in the production of Photographic pictures upon paper or any unoled body or surface.

Witnesses.

J. S. HOLLINGSHEAD, }
E. G. HANDY. }

JOEL HAYWOOD TATUM.

Original, dated April, 15, 1856.

Re-issue, dated May 13, 1856.

PATENT FOR MAKING THE BORDER OF THE PICTURE TRANSPARENT, AND PLACING THE MAT BACK OF THE PICTURE.

To all whom it may concern:

Be it known that we, ALBERT BISBEE, of Columbus, in the County of Franklin and State of Ohio, and Y. DAY, of Nash-

ville, in the County of Davidson and State of Tennessee, have invented certain new and useful improvements in photographic pictures on glass, and we do hereby declare the following to be a full, clear and exact description of the same.

The nature of our invention consists in making the edges of the coating or film on the glass transparent so that the picture is made only on the central part of the glass, and extending so far as to meet the inside edge of the mat or border, generally used in putting up such pictures, and then placing the mat back of the picture.

To enable others skilled in the art to make and use our invention, we will proceed to describe the same as follows:—

We place inside of the camera, and about one-tenth of the focal distance of the lens from the glass, a board having an aperture of any desired pattern that we wish the edges to have. This board shades the edges of the glass, thereby leaving them transparent in the picture. Then the picture, being taken in the usual manner, is finished by varnishing with transparent white varnish, and then backed with japan varnish, care being taken to have the japan on the back extend only to meet the inside edges of the mat. Then we place the mat back of the picture and secure it in its place with the preserver.

If applied to the process, as patented by J. A. Cutting, with two glasses, the picture is made as above described, and then the second glass is applied, and finished as before by backing with japan.

The advantage of our improvement, is in having the mat protected from being soiled, and making the picture appear more round, causing an illusion as though the picture or image was suspended in the atmosphere, clear from the back-ground.

Having thus fully described the nature of our invention, what we claim therein as new, and desire to secure by Letters Patent, is, making the border of the picture transparent and placing the mat back of the picture, as described in the above specification, and for the purpose set forth.

Witnesses to the signature of

A. Bisbee.

C. A. BARKER, }
WM. FIELD. }

A. BISBEE.

Witnesses to the signature of

Y. Day.

B. BINGHAM, }
W. ATKINS. }

Y. DAY.

Dated May 27th, 1856.

PATENT FOR THE APPLICATION OF COLORING SUBSTANCES,
OR MATTER, TO PHOTOGRAPHIC IMPRESSIONS.

Be it known that I, GILES LANGDELL, and MARCUS A. ROOT, of Philadelphia, in the State of Pennsylvania, have invented a new and improved mode of coloring daguerreotype and other photographic portraits or pictures made on glass, metal or other material; and we do hereby declare that the following is a full and exact description:—

The nature of our invention or discovery consists in providing and applying both mineral and vegetable coloring matters in *solution* to the daguerreotype or any other photographic impression, introducing the said coloring matter either into the collodion or the developer, or by pouring upon the plate after the impression is fixed by hyposulphite of soda, or the cyanide of potassium, or by any other means.

The several coloring substances, E. G. red saunders, alkanet, dragons' blood, &c., &c., can be used separately or in conjunction or compounded with various mineral substances, or with any coloring matters obtained from other roots, woods, gums or other vegetable matter, the proportions or quantity employed being varied or regulated by the lightness or depth and strength of tone which may, from time to time, be required.

The desired or similar results may be obtained from different formulæ. The following answers for all practical purposes, but may be varied at pleasure:—

Digest for two or three days red saunders (*pterocarpus santalinus*) half a pound in three pints of water to which the aqua ammonia has been added. Then pour off the solution and precipitate by the addition of nitric acid. Wash the precipitate thoroughly with water and dry it. Then dissolve it in strong alcohol and dilute with the same as required to produce the tone or tint that may be desired. Alkanet (*anchusa tinctoria*) may be prepared in the same way. Dragons' blood dissolved in alcohol and treated in the same manner will produce the various shades of yellow. The foregoing

articles, and also madder, indigo, cochineal, and some other coloring substances both vegetable and mineral alone or combined, will produce pleasing results when applied as follows (although they may be introduced into the collodion) :—

We prefer first to develop the impression, then to fix and dry it, and afterwards to flow on the toning or tinting solution, as collodion or varnish, &c., is poured upon the plate, allowing the solution to run off the corner, and then levelling the plate to make the fluid flow uniformly over and tint the whole surface of the plate evenly.

Then wash at once and thoroughly with clean water, and stand the plate up to dry, after which it may be colored (the dress of any tint or color desired—the face, hands, &c, are flesh tint) with dry colors (as is usual in coloring daguerreotypes) applied to the collodion or upon the varnish.

What we claim as our invention and discovery, and desire to secure by Letters Patent, is the application of coloring substances or matter to Photographic impressions or pictures upon glass or metal, or other material in the form and manner herein described.

Witnesses.

JAMES J. B. OGLE, }
WILLIAMS OGLE, }

GILES LANGDELL [L. S.]
M. A. ROOT. [L. S.]

Dated July 15th, 1856.

PATENT FOR THE USE OF ALBUMENIZED COLLODION.

To all whom it may concern :

Be it remembered, that I, VICTOR M. GRISWOLD, of the City of Lancaster, in the County of Fairfield and State of Ohio, have invented certain improvements in the art and mode of taking Photographic Pictures, and I do hereby declare that the following is a full and exact description thereof:

The nature of my invention consists in an improvement in the photographic art of taking pictures. To one quart of collodion prepared in the usual way or manner, I add three ounces of a solution

prepared thus: The clear solution which results from the whites of eggs which have been well beaten, and one equal bulk of pure soft water. When this is added to the collodion, it is thrown to the bottom in long stringy white masses, which after a few days impart to the liquid albuminous properties, rendering the film closer in texture, and bringing out all the minor details more sharply and perfectly than by the ordinary collodion, and giving to the picture a glossy and sparkling tone, unlike any produced by other means.

Another method which I frequently adopt is thus; albumen as above, without water, to which is added iodide of potassium forty grains; this throws down the albumen in jelly-like masses, and, when added to the collodion, not only iodizes it, but produces the same effect upon the collodion as by the formula above. Also, another method: one ounce of chloroform, to which is added one half ounce of albumen, prepared as above, iodized; this forms also a soft semi-transparent jelly, which on being added to the collodion produces perhaps the best effect of any of these preparations.

This addition of albumen also answers a far better purpose than any that has hitherto been employed for freeing old samples of collodion from free iodine held in suspension by which they can be rendered as clear and limpid as they were when first mixed.

What I claim as my invention, and desire to secure by Letters Patent is the addition of albumen to collodion in the manner and for the purpose herein and above specified.

V. M. GRISWOLD.

ALFRED M'VEIGH, }
J. C. HEULEY. } *Witnesses.*

Patented July 15th, 1856.

COLORING AMBROTYPES.

To all whom it may concern:

Be it known that we, D. B. SPOONER and H. B. SPOONER, of Springfield, in the County of Hampden, in the State of Massachu-

setts, having invented new and useful improvements in coloring Ambrotype or Photographic Pictures on glass, and we do hereby declare that the following is a full and exact description thereof :—

The nature of our invention consists, in so preparing the collodion film containing the picture in alternate placers with gum or other suitable material, so that when a penetrating dye or pigment, in a solution that will penetrate the collodion film, may be deposited on any particular portion of the picture between the collodion film and the glass, in order to give it the requisite color properly distributed between the face, drapery, &c.

The following is the process adopted :—

After the picture is thoroughly washed and dried, proceed with a brush to cover any portion of the picture not designed to take the color, with a solution of gum or any other substance insoluble in the coloring solution, but soluble in any other liquid in which the coloring matter is not soluble.

E. G.—Take a solution of gum arabic in water, and apply it to a portion of the picture. Now take a solution of turmeric in alcohol, and pour it upon the collodion surface of the picture, and you immediately get a deposit of the coloring matter between the collodion and the glass, the portion of the picture covered with the gum not being penetrated by the alcohol, is protected from the color while all other portions are colored.

Then, by washing the picture in water, the gum is dissolved and washed off, and the parts uncolored may remain in their natural state without color, or, by applying the gum solution to the portion already colored with a part of the uncolored portion, another color may be produced by the use of another pigment in the same manner as before described.

In this manner any number of colors may be produced ; or, when a small portion only of the picture is to be colored, the whole of the picture may be colored and dried, and then that portion which is to retain the color may be covered with the gum solution, and the coloring matter not protected by the gum may be extracted with alcohol or other solvent, and the gum washed off as before.

The advantages of our invention consist in depositing the coloring matter in its *various tints* on the front side of the picture between the collodion and the glass, instead of coloring the fibre of the collodion, or the upper side of it, as is common, which does not show through to the positive side of the picture on account of the opacity of the silver deposit which forms the picture.

We do not claim the coloring of a picture all over with a single tint, but

What we claim as our invention and desire to secure by Letters Patent, is the application of gum arabic or other equivalent material, as set forth in the specification, for the purposes therein described, and no other.

Witnesses.

GEORGE W. ADAMS, }
CHAS. H. CODMAN. }

D. B. SPOONER.
H. B. SPOONER.

Patented August 5, 1856.

CHAPTER VIII.

THE COLLODIO-ALBUMEN PROCESS.

This is a process, invented by Dr. Taupenot, for obtaining negatives on glass, which bids fair to outrival all others, being easy of manipulation, and giving results of the most exquisite minutiae and beauty. Glass plates, when prepared and excited by this process, may be kept at least a fortnight before being developed, and these plates when exposed in the frame may be developed immediately, or kept for days before commencing this operation. Indeed it is quite possible to prepare and excite a number of plates before leaving home to go on a tour of twelve or fourteen days ; to expose the plates at any time or place during the journey, and bring them home to be developed.

The manipulation may be said to consist of nine distinct operations.

1. Cleaning the plate. 2. Coating with iodized collodion. 3. Exciting the collodion film. 4. Coating with albumen. 5. Exciting the albumen coating. 6. Exposure in the camera. 7. Developing the image. 8. Fixing the image. 9. Varnishing the plate.

Before describing these operations, I propose to give clear directions for preparing the necessary solutions, merely promising that, where I have deviated from the inventor's plan, it has been after performing careful experiments, to test the merits of the two modes of proceeding.

The necessary solutions for this process are :

Collodion bath solution. Iodized collodion. Iodized albumen. Albumen bath solution. Pyrogallie solution. Silver developing solution. Fixing solution.

Collodion Bath Solution.

Nitrate of silver in crystals	-	-	-	1 ounce.
Iodide of potassium	-	-	-	2 grains.
Distilled water	-	-	-	16 ounces.
Alcohol	-	-	-	2 drachms.

Dissolve the ounce of nitrate of silver in two ounces of the distilled water, and the two grains of iodide of potassium in one drachm of distilled water ; mix the two solutions and shake well together until the precipitate which is first thrown down is redis-

solved ; when this takes place, add the remaining fourteen ounces of distilled water, and the two drachms of alcohol. On the addition of the water a turbidness ensues, which must be removed by the solution being very carefully filtered through filtering paper ; and the filtered liquid should be clear and transparent, free from any deposit or floating particles, and must possess a slightly acid reaction of test-paper.

In order to ascertain if the solution thus prepared possesses the necessary amount of free acid without superabundance, proceed to test and to correct it, if necessary.

Iodized Collodion.

The collodion to be used in this process must be one yielding good *negative* pictures—that supplied by Horne & Thornthwaite under the name of negative collodion answers admirably. This is supplied either ready iodized, or the collodion and iodizing in separate bottles. As this collodion becomes less sensitive after being iodized a fortnight, it is advisable to iodize no more than will be used in that time—therefore, obtain the collodion and the iodizing solution separate, as the mode of iodizing this collodion is very simple. Half an ounce of the iodizing solution is mixed with one ounce and a half of collodion, and the mixture allowed to settle twelve hours before being used ; and it is even advisable to pour off the clear solution into a perfectly clean bottle, in order to get rid of any insoluble matter which may fall to the bottom.

Iodized Albumen.

White of egg (free from yolk)	-	-	-	-	10 ounces.
Honey	-	-	-	-	1 ounce.
Iodide of calcium	-	-	-	-	2 scruples.
Yeast	-	-	-	-	1 tablespoonful.

Mix these together in a tall glass jar, or wide-mouthed bottle of at least one pint capacity ; tie a piece of paper, pierce with small holes over the top to keep out dust ; then place the whole near a fire or other warm situation, where the temperature is not lower than seventy degrees, or higher than ninety degrees. In a few hours fermentation commences, which is evident by the formation of bubbles of gas, rising through the liquid. This action continues for five or six days ; when it ceases, pour the whole on a paper-filter contained in a funnel, underneath which must be placed a bottle to receive the liquid as it passes through. The fluid being of a viscid nature filters slowly, generally occupying twelve hours.

The filtered liquid is the “iodized albumen,” which is said by

Dr. Taupenot to keep good for years. It must be carefully preserved from dust or contact with any substance, as the success of the picture depends materially on the condition of this albumen.

Albumen Bath Solution.

Nitrate of silver	-	-	-	-	-	1 ounce and a half.
Acetic acid, glacial	-	-	-	-	-	1 ounce.
Distilled water	-	-	-	-	-	16 ounces.
Animal charcoal	-	-	-	-	-	2 drachms.

Dissolve the nitrate of silver in the distilled water, then add the acetic acid and animal charcoal, and keep in a closely stoppered bottle for use.

Pyrogallic Solution.

Pyrogallic acid	-	-	-	-	-	15 grains.
Glacial acetic acid	-	-	-	-	-	2 drachms.
Alcohol	-	-	-	-	-	2 drachms.
Distilled water	-	-	-	-	-	7 ounces.

Dissolve the pyrogallic acid in the distilled water, and then add the acetic acid and alcohol.

Silver Developing Solution.

Nitrate of silver	-	-	-	-	-	1 drachm.
Acetic acid	-	-	-	-	-	2 drachms.
Distilled water	-	-	-	-	-	7 ounces.

Dissolve the nitrate of silver in the distilled water, and then add the acetic acid.

Fixing Solution.

Hyposulphite of soda	-	-	-	-	-	2 ounces.
Water	-	-	-	-	-	1 pint—dissolve.

Varnish.

The varnish best adapted for this purpose is that supplied by Horne & Thornthwaite, and termed negative varnish.*

Cleaning the Plate.

The plates must be cleaned in the usual way, merely premising that extra care must be observed to remove every impurity, as cleanliness in photography is an absolute necessity.

* In this country, Humphrey's Collodion Gilding is the article in almost universal use.

In order to hold large plates whilst being cleaned, the "screw plate-holder" is exceedingly useful. This is made in three sizes, and adapts itself to all sized plates.

The small size is useful for plates up to 7 inches by 6.

The second size is for plates up to 10 inches by 8.

And the third size for plates up to 14 inches by 10.

Coating with Iodized Collodion.

The plate having been thoroughly cleaned, and received its final polish by the use of a prepared chamois leather, is coated with negative collodion, which has been iodized at least twelve hours, and allowed to settle.

*Exciting the Collodion Film.**

After the ether has evaporated, and the surface of the collodion appears set, the plate must be laid, collodion side upwards, on a glass dipper, and plunged with *one downward movement* into a bath filled to within an inch of the top with collodion bath solution, made as described at page 190, which must be carefully filtered through filtering paper before being used. After the plate has been allowed to remain in the bath one minute, it is lifted out three or four times, in order to facilitate the removal of the *oily* appearance the plate now presents. When the surface appears wetted uniformly, on being drawn out of the solution the plate is removed from the dipper, and the excess of solution drained off, and is then placed collodion side upwards, on a fixing stand, and distilled or filtered rain water poured over the surface, so as to remove as much as possible of the bath solution from the surface. The plate is now removed from the fixing stand; the back well washed with water, and then placed nearly upright on blotting paper, with the face against a wall for *one minute* to drain.

Coating with Albumen.

Having allowed the plate to drain one minute, place it again on a levelling stand, with the film upwards, and pour over it as much of the iodized albumen as the plate will hold, from a glass measure containing not more than enough of the albumen to coat two plates with, pour off the excess into the measure, and again cover the plate with albumen three separate times; ultimately drain off as much as possible of the excess of albumen, and place the plate nearly upright against the wall,

* This and subsequent operations (except exposure in the camera) must be performed in a dark room.

with the coated side inwards, to dry, which takes place in an ordinary temperature in about one hour.

In coating with albumen, the presence of air-bubbles or dust must be guarded against. The former can be easily done by taking care, in pouring the albumen into the measure and on the plate, not to pour so as to generate air-bubbles in the liquid. But should any be detected, hold the plate horizontally and give it another coating of albumen, then incline the plate so that the bulk of the liquid shall pass over and carry off the bubbles with the running stream. Dust on the plate must be prevented by operating in a room as free from this photographic enemy as possible.

In order to render the coating of albumen as uniform as possible, the plate must stand to dry on two or three layers of filtering paper and the upper surface must touch the wall at *one point only* and not to be allowed to rest against it along its entire upper edge.

When the albumen coating is *thoroughly dry* (and not till then), the plate is ready to be excited, but if more have been prepared than are likely to be used for taking pictures on during the next ten days or fortnight, they may be stowed away in a plate box, ready to receive the sensitive coating at any time. The author's experience has led him to believe that these albumenized plates will keep good any length of time, as plates which had been coated a month, when excited, exposed, and developed, appeared to possess all the properties of recently prepared plates.

Exciting the Albumen Coating.

Prior to the plates being excited they must be *thoroughly dry* and free from any particles of loose dust on the surface, back, or edge. Sufficient of the albumen bath solution, page 192, must be filtered through filtering paper to fill a dipping bath of the required size, so that the plate can be immersed in it.

The careful filtering of the fluid is very necessary in order to free it from any floating particles, and to separate the animal charcoal.

The plate is now taken and laid, albumen side upwards, on the dipper, and then lowered into the bath with one steady downward movement, where it is allowed to remain one minute; it is then taken out, the excess of liquid drained off, and placed on the fixing stand, with the albumen surface uppermost, and a stream of water poured over it for at least one minute, so as to remove every particle of the bath solution. This complete washing is very necessary, in order to prevent stains in the after development, which invariably takes place around the edges, if not thoroughly washed. The plate having been thoroughly washed, is leaned against a wall to dry, or if required for immediate exposure, may be dried on a plate of heated metal or foot warmer, but in no case must the exposure in the camera take place until the surface is thoroughly dry.

*Exposure in the Camera.**

As has been before stated, this operation may take place immediately the plate is thoroughly dry after being excited, or a fortnight may intervene between the excitement and exposure, provided the plate is kept very carefully excluded from light and any chemical or sulphurous vapors, in a plate-box adapted for that purpose, with the sensitive surface towards the back of the box. When the exposure is about to take place, or at any time previously, the camera-backs may each have a plate placed in them ready for exposure; to do this, the camera-back must be taken into the operating room and the door closed, so as to exclude all white light. The hinged flap of the camera back is opened, and the prepared plate laid, with its sensitive surface downwards, or next the sliding flap, so that its corners may rest on the silver wire corners of the plate frame previously placed within the camera back ready to receive it. The hinged flap is now closed and kept from opening by turning the flap button over it; the sliding flap is examined to see that it is pushed closely down so as to guard any access of light, and it is then ready to be placed in the camera, and may be taken into the open air with impunity. Should the exposure not take place immediately, or, should the camera back have to be carried any distance, it is advisable either to wrap it up in black cloth, or secure the flaps from the chance of coming open during transit, by a stout string being tied around the back.

The focussing is conducted in the usual way and the cap replaced on the lens; the focussing glass is now removed and the camera back fitted into the same aperture, with the sliding flap *next* the lens. The sliding flap is pulled up to its fullest extent, placing the hand on the camera back to prevent it rising out of the camera with this action. The cap of the lens is then removed, so that the light may be admitted into the camera, and to fall on the sensitive surface of the plate. After the necessary time of exposure has taken place, the cap is replaced on the lens, the sliding flap is pushed down, and the camera back withdrawn from the camera; the plate can then be taken into the operating room to be developed, or this operation may be deferred for days or even a week, or more if convenient. The time of exposure in the camera varies according to the intensity of the light and the aperture and focal length of the lens; therefore, to give the exact time of exposure would be impossible, still it may assist the amateur if I give the time required in summer with full sunshine, and

* Remarks as to the selection of the view, &c., are not given, as this can be effected by the individual taste of the operator, but care must be taken that direct rays from the sun shall not fall on the lens or enter the camera during the exposure of a plate.

merely state that this time may be increased to double in winter or dull weather.

In the ordinary sunshine of a summer's day the time of exposure will be :

- 30 seconds with a lens of 4-inch focus and $\frac{1}{2}$ -inch stop.
- 21 seconds with a lens of 4-inch focus and $\frac{5}{8}$ -inch stop.
- 5 seconds with a lens of 4-inch focus and $1\frac{1}{4}$ inch aperture with no stop.
- $1\frac{1}{2}$ minute with a lens of 6-inch focus and $\frac{1}{2}$ -inch stop.
- $4\frac{1}{2}$ seconds with a lens of 6-inch focus and $2\frac{1}{4}$ -inch aperture with no stop.
- 2 minutes with a lens of 8-inch focus and $\frac{1}{2}$ -inch stop.
- $1\frac{1}{4}$ minute with a lens of 8-inch focus and $\frac{5}{8}$ -inch stop.
- $3\frac{1}{4}$ minutes with a lens of 10-inch focus and $\frac{1}{2}$ -inch stop.
- 2 minutes with a lens of 10-inch focus and $\frac{5}{8}$ -inch stop.
- 5 seconds with a lens of 10-inch focus, $3\frac{1}{4}$ -inch aperture, with no stop.
- $6\frac{1}{2}$ minutes with a lens of 14-inch focus and $\frac{1}{2}$ -inch stop.
- 4 minutes with a lens of 14-inch focus and $\frac{5}{8}$ -inch stop.
- $2\frac{1}{2}$ minutes with a lens of 14-inch focus and $\frac{3}{4}$ -inch stop.
- $8\frac{1}{4}$ minutes with a lens of 16-inch focus and $\frac{1}{2}$ -inch stop.
- $5\frac{1}{2}$ minutes with a lens of 16-inch focus and $\frac{5}{8}$ -inch stop.
- $2\frac{1}{2}$ minutes with a lens of 16-inch focus and $\frac{3}{4}$ -inch stop.

Developing the Image.

The camera back is taken into the operating room, from which all white light is carefully excluded, the plate removed from the camera back, and laid, albumen side upwards, on the fixing stand; as much distilled water is now poured on it as the surface will hold, taking care that every part of the sensitive surface is covered with the liquid; allow the water to remain on the surface for one minute, then pour off and drain slightly; replace the plate on the stand, and pour over the surface so as thoroughly to cover every part, the pyrogallie solution (made as described at page 192, and carefully filtered just before being used); allow this to remain on the plate for one minute, then drain off into a perfectly clean measure, and add to it an equal bulk of silver developing solution, page 192; mix these thoroughly together with a glass rod, and then pour the mixed liquids over the plate; allow them to rest until the picture begins to appear, which generally takes about from three to five minutes; then pour off and on repeatedly, until the developing fluid becomes opaque, which then contains floating particles, and these, if allowed to do so, would settle on the plate, to the injury of the picture; but this may be prevented by brushing the surface with a camel's hair brush frequently during the development. When this opacity of

the developing fluid takes place, drain all the fluid off the plate, and thoroughly wash with water; then mix another quantity of pyrogallie and silver developing solution in the same proportions as before, and pour this on and off the plate as before, until the picture appears sufficiently intense, and the middle shades well brought out; when this takes place drain off, and wash with water, so as to clean the surface thoroughly, and the plate is then ready for the next step, "fixing the image."

Should the picture begin to develop in less than three minutes after the application of the mixed developing fluids, thoroughly drain the plate, and wash well with water, then continue the development with a solution of three parts pyrogallie solution and one part silver developing solution; but should the picture not begin to appear in five minutes, the addition of half a drachm of the albumen bath solution to each ounce of mixed developing solution will be necessary, in order to obtain the middle shades and the required intensity. It may be stated, as a guide, that the best negatives which the author has produced occupied from ten to twelve minutes in developing.

Fixing the Image.

The plate, having been thoroughly freed from the developing fluid by careful washing, is now placed on the fixing stand, and the surface covered by the fixing solution, made as described at page 192, being poured over it. In a few seconds the yellow opalescent color of the film will begin to disappear, and its complete removal may be hastened by blowing gently on the plate, so as to disturb the fluid.

When every particle of yellowness has disappeared, the fixing solution is drained off, and the surface *thoroughly* washed, and it is then leaned against the wall to drain and dry.

Varnishing the Plate.

The plate, being thoroughly dry, is ready to receive a coating of transparent varnish,* in order to protect the albumen surface from injury during the printing process. To do this effectually the plate must be held before a fire, or over a lamp, until it is slightly warm all over; then pour over its surface the negative varnish, in the same manner as collodion is applied; allow the superfluous varnish to drain back into the bottle; hold the plate again before the fire until the whole of the spirit is evaporated; and, when cold, the plate is ready to be printed from, so as to produce any number of positive pictures on paper.

It will be observed, that in describing this process, the ope-

* Humphrey's Collodion Gilding is the best for this purpose.

rator has been supposed to be so situated, that in case a second view of the same spot were required, he could return to his operating room, remove the plate which had been exposed, from the camera back to the plate box, and place another in the camera back, ready for taking another view. But, unfortunately, this is not at all times practicable. We, therefore, require some means of removing the plates, after being exposed, from the camera back into the plate box, and substituting others in their stead, whilst we are in the open air.

In order to effect this, the "field plate box" has been devised by the author, by the aid of which the plates may be removed from the box, exposed in the camera, and again returned into the box, without any possibility of access of light falling on it.

This box is but a trifle larger than the ordinary one, and is furnished with two sliding bottoms, working in grooves, one over the other; the lower bottom has a grooved channel, into which the side of the camera back slides; the camera back has an aperture through the side, closed by a narrow slide, and the lower bottom of the field box has a corresponding one. We now suppose the field box to have been previously filled with excited glass plates, having their sensitive sides towards the back of the box, and the box lid closed. The bottom slide is now pushed on until the aperture is in a line with any particular groove of the field box (which position is indicated by a numbered scale and index point). The camera back is then slid on to its place on the field box, so that the hinged flap is towards the front of the box, and its narrow slide drawn out. The upper slide is then withdrawn, and the box inclined, so that the plate in that groove opposite the aperture in the lower slide, may pass through into the camera back. When this has taken place, push in the narrow slide of the camera back, invert the box, and push in the inner slide; then withdraw the camera back from its channel, and expose the plate in the camera. When this is done, slide the back again into its channel, draw out the inner box slide, then the narrow camera back slide, invert the box, and the plate will then leave the camera back and pass into the field box, occupying the same groove as before.

In order to get out another plate, slide the lower bottom, so that the index points to the number on the scale, as that of the groove in which the required plate is situate. Then proceed as before directed.

CHAPTER IX.

ON A MODE OF PRINTING ENLARGED AND REDUCED POSITIVES, ETC., FROM COLLODION NEGATIVES.

To explain the manner in which a photograph may be enlarged or reduced in the process of printing, it will be necessary to refer to the remarks made at page 20, on the *conjugate foci* of lenses.

If a collodion negative be placed at a certain distance in front of a camera, and (by using a tube of black cloth) the light be admitted into the dark chamber only through the negative, a reduced image will be formed upon the ground glass; but if the negative be advanced nearer, the image will increase in size, until it becomes first equal to, and then larger than, the original negative; the focus becoming more and more distant from the lens, or *receding*, as the negative is brought nearer.

Again, if a negative portrait be placed in the camera slide, and if the instrument be carried into a dark room, a hole be cut in the window-shutter so as to admit light through the negative, the luminous rays, after refraction by the lens, will form an image of the exact size of life upon a white screen placed in the position originally occupied by the sitter. These two planes, in fact, that of the object and of the image, are strictly *conjugate foci*, and, as regards the result, it is immaterial from which of the two, anterior or posterior, the rays of light proceed.

Therefore in order to obtain a reduced or enlarged copy of a negative, it is necessary only to form an image of the size required, and to project the image upon a sensitive surface either of collodion or paper.

A good arrangement for this purpose may be made by taking an ordinary portrait camera, and prolonging it in front by a deal box blackened inside and with a double body, to admit of being lengthened out as required; or, more simply, by adding a framework of wood covered in with black cloth. A groove in front carries the negative, or receives the slide containing the sensitive layer, as the case may be.

In reducing photographs, the negative is placed in front of the lens, in the position ordinarily occupied by the object; but in making an enlarged copy it must be fixed behind the lens, or, which is equivalent, the lens must be turned round so that the rays of light,

transmitted by the negative, enter the back glass of the combination, and pass out at the front. This point should be attended to in order to avoid indistinctness of image from spherical aberration.

A portrait combination of lenses of $2\frac{1}{2}$ or $3\frac{1}{4}$ inches is the best form to use, and the actinic and luminous foci should accurately correspond, as any difference between them would be increased by enlarging. A stop of an inch or an inch and a half aperture placed between the lenses obviates to some extent the loss of sharp outline usually following enlargement of the image.

The light may be admitted through the negative by pointing the camera towards the sky; or direct sunlight may be used, thrown upon the negative by a plane reflector. A common swing looking-glass, if clear and free from specks, does very well; it should be so placed that the centre on which it turns is on a level with the axis of the lens.

The best negatives for printing enlarged positives are those which are distinct and clear; and it is important to use a small negative, which strains the lens less and gives better results than one of larger size. In printing by $2\frac{1}{4}$ lens for instance, prepare the negative upon a plate about two inches square and afterwards enlarge it four diameters.

Paper containing chloride of silver is not sufficiently sensitive to receive the image, and the print should be formed upon collodion, or on iodized paper developed by gallic acid.

The exposure required will vary not only with the intensity of the light and the sensibility of the surface used, but also with the degree of reduction or enlargement of the image.

In printing upon collodion the resulting picture is positive by transmitted light; it should be backed up with white varnish, and then becomes positive by reflected light. The tone of the blacks is improved by treating the plate first with bichloride of mercury, and then with ammonia.

Mr. Wenham, who has written a most practical paper on the mode of obtaining positives of the life size, operates in the following way:—he places the camera, with the slide containing the negative in a dark room, and reflects the sunlight in through a hole in the shutter, so as to pass first through the negative and then through the lens; the image is received upon iodized paper, and developed by gallic acid.

On Printing Collodion Transparencies for the Stereoscope.—This may be done by using the camera to form an image of the negative in the mode described at the last page; but more simply by the following process:—Coat the glass, upon which the print is to be formed, with collodio-iodide of silver in the usual way, then lay it upon a piece of black cloth, collodion side uppermost, and place two strips of paper of about the thickness of cardboard and one-fourth of an inch broad, along the two opposite edges, to prevent

the negative being soiled by contact with the film. Both glasses must be perfectly flat, and even then it may happen that the negative is unavoidably wetted; if so, wash it immediately with water, and if it be properly varnished no harm will result.

A little ingenuity will suggest a simple framework of wood, on which the negative and sensitive plate are retained, separated only by the thickness of a sheet of paper; and the use of this will be better than holding the combination in the hand.

The printing is conducted by the light of gas or of a camphine or moderator lamp, diffused daylight would be too powerful.

The employment of a concave reflector, which may be purchased for a few shillings, ensures parallelism of rays, and is a great improvement. The lamp is placed in the focus of the mirror, which may at once be ascertained by moving it backwards and forwards until an *evenly illuminated circle* is thrown upon a white screen held in front. This in fact is one of the disadvantages of printing by a naked flame—that the light falls most powerfully upon the central part, and less so upon the edges, of the negative.

(From Humphrey's Journal, No. 17, Vol. 8.)

ON THE USE OF ALCOHOL FOR SENSITIZING PAPER.

I have practised for some time the following simple method, which appears to me to be very superior for cleanliness and celerity in working, for depth of tone, and especially for purity of white in its results. By means of it I have produced very satisfactory results upon paper which was otherwise nearly worthless.

To your sensitizing solution (which should be not less than 60 grains to the ounce), whether simple nitrate or ammonio-nitrate, add 50 per cent. of alcohol. Float the paper upon the solution for 40 seconds.

This method answers equally well for albumenized or plain paper. You will find that the solution penetrates the paper which flattens *instantaneously* upon it. It becomes as transparent as though it were oiled, and every minute air-bubble or defect in the paper is rendered visible. Remove the air-bubbles by pressing upon the paper about an inch from the bubble, and thus driving it out under the paper. In doing this, if the solution flows partially over the back of the paper, shake it until the paper is wholly

immersed, which will prevent any unevenness in printing. The paper reassumes its transparency in the toning bath, but it will dry a pure white. The sensitizing solution will not become materially discolored even after frequent applications of albumenized paper. Should it become so much discolored as to give a dark hue to the paper, shake it in a bottle with two drachms of animal charcoal and leave it a night to settle. It will filter clear. A very small portion of your solution may be made available in sensitizing a sheet of paper by pouring it upon a clean glass, the size of the paper or a little larger, which is carefully levelled and nicely laying down the paper upon it. This is useful when your solution is too small to float in your trays. The alcohol causes it to flow and be absorbed with perfect evenness.

To remove the papers from the solution and dry them :—Provide a dozen or more clothes-pins, of the kind that are supplied with a ring of india-rubber for a spring. Into the top drive a pin firmly and bend it to a hook. Lift a corner of the paper by passing under it the point of a quill tooth-pick, and attach to it one of the clothes-pins ; lift the edge out by this, and attach another to the other corner. You may thus carry the sheet by the pins and hang it upon a line to dry without touching it with the fingers, a matter of some importance to Amateurs of the art, who must have unstained hands for their day's *business*.

It may be worth while here to add the following simple and economical method of printing, which I have found to surpass in convenience and afford all the advantages of the most expensive printing frames. Four common clothes-pins, such as work with a *wire* spring supply pressure enough for a $\frac{1}{4}$ -plate. Lay your prepared paper upon the negative, and next to it about twenty *separate leaves* of thin common wrapping paper cut to the size of the negative ; next a sheet of tolerably stiff and smooth writing paper, and lastly, a piece of glass as a back to the whole. Let the glass back be pushed from the lower edge of the papers about 1–20 of an inch, or just so far as to enable you to pinch the negative and

papers with the thumb-nail and forefinger. Attach a pin to each corner and your negative is prepared for exposure. Now, to examine your picture without endangering its displacement:—remove the pins from one end, and place it, face downwards, on a table, the other end with pins attached projecting an inch beyond the edge. Hold down the back glass with the left hand, while with the right you remove the pins and pinch the papers and negative together between the forefinger and thumb-nail. Upon the smooth sheet of paper you can easily slide the back glass an inch from the edge. Hold it there, and on the uncovered margin attach *three* of the pins with as deep a bite as they will take. You may now examine your picture to within an inch of its margin, as you would turn over the leaves of a book. To replace the back, lay it again on the table and slide the back glass up to the pins before you remove them. The rest of the process is obvious.

The minutiae of my communication may excite a smile with some, but I shall always act upon the principle, that nothing is more out of place than an apology for minuteness in describing manipulations.

G. B. C.

RECOVERY OF SILVER FROM WASTE SOLUTIONS,—FROM THE BLACK DEPOSIT OF HYPO BATHS, ETC.

The manner for separating metallic silver from waste solutions varies according to the presence or absence of alkaline hyposulphite and cyanides.

a. *Separation of metallic Silver from old Nitrate Baths.*—The silver contained in solutions of the nitrate, acetate, etc., may easily be precipitated by suspending a strip of sheet copper in the liquid; the action is completed in two or three days, the whole of the nitric acid and oxygen passing to the copper, and forming a blue solution of the nitrate of copper. The metallic silver however separated in this manner, always contains a portion of copper, and gives a blue solution when dissolved in nitric acid.

A better process is to commence by precipitating the silver entirely in the form of *chloride of silver*, by adding common salt until no further milkiness can be produced. If the liquid is well stirred, the chloride of silver sinks to the bottom, and may be washed by repeatedly filling the vessel with common water, and pouring off the upper clear portion when the clots have again settled down. The chloride of silver thus formed may afterwards be reduced to metallic silver by a process which will presently be described.

b. *Separation of Silver from solutions containing alkaline Hyposulphites, Cyanides or Iodides.*—In this case the silver cannot be precipitated by adding chloride of sodium, since the chloride of silver is *soluble* in such liquids. Therefore it is necessary to use the sulphuretted hydrogen, or the hydrosulphate of ammonia, and to separate the silver in the form of *sulphuret*.

Sulphuretted hydrogen gas is readily prepared, by fitting a cork and flexible tubing to the neck of a pint bottle, and having introduced *sulphuret of iron* (sold by operative chemists for the purpose), about as much as will stand in the palm of the hand, pouring upon it $1\frac{1}{2}$ fluid ounces of oil of vitriol diluted with 10 ounces of water. The gas is generated gradually without the application of heat, and must be allowed to bubble up through the liquid from which the silver is to be separated. The smell of sulphuretted hydrogen being offensive, and highly poisonous if inhaled in a concentrated form, the operation must be carried on in the open air, or in a place where the fumes may escape without doing injury.

When the liquid begins to acquire a strong and persistent odor of sulphuretted hydrogen, the precipitation of sulphuret is completed. The black mass must therefore be collected upon a filter, and washed by pouring water over it, until the liquid which runs through gives little or no precipitation with a drop of nitrate of silver.

The silver may also be separated in the form of sulphuret from old hypo baths, by adding oil of vitriol in quantity sufficient to de-

compose the hyposulphite of soda ; and burning off the free sulphur from the brown deposit.

Conversion of Sulphuret of Silver into Metallic Silver.—The black sulphuret of silver may be reduced to the state of metal by roasting and subsequent fusion with carbonate of soda ; but it is more convenient, in operating on a small scale, to proceed in the following manner :—first convert the sulphuret into nitrate of silver, by boiling with nitric acid diluted with two parts of water ; when all evolution of red fumes has ceased, the liquid may be diluted, allowed to cool, and filtered from the insoluble portion, which consists principally of sulphur, but also contains a mixture of chloride and sulphuret of silver, unless the nitric acid employed was free from chlorine ; this precipitate may be heated in order to volatilize the sulphur, and then digested with hyposulphite of soda, or added to the hypo bath.

The solution of nitrate of silver obtained by dissolving sulphuret of silver is always strongly acid with nitric acid, and also contains *sulphate* of silver. It may be crystallized by evaporation ; but unless the quantity of material operated on is large, it will be better to precipitate the silver in the form of chloride, by adding common salt, as already recommended.

ON THE USE OF TEST PAPERS.

The nature of the coloring matter which is employed in the preparation of litmus-paper has already been described at page 98.

In testing for the alkalies and basic oxides generally, the blue litmus-paper which has been reddened by an acid may be used, or, in place of it, the turmeric paper. Turmeric is a yellow vegetable substance which possesses the property of becoming brown when treated with an alkali ; it is however decidedly less sensitive than the reddened litmus, and is scarcely affected by the weaker bases, such as oxide of silver.

In using test papers observe the following precautions :—they

should be kept in a dark place, and protected from the action of the air, or they soon become purple from carbonic acid, always present in the atmosphere in small quantity. By immersion in water containing about one drop of liquor potassæ in four ounces, the blue color is restored.

Test-papers prepared with porous paper show the red color better than those upon glazed or strongly sized paper. If the quantity of acid present however is small, it is not sufficient in any case simply to dip the paper in the liquid; a small strip should be thrown in, and allowed to remain for ten minutes or a quarter of an hour.

If the paper, on immersion, assumes a *wine-red* or purple tint, in place of a decided red, it is probably caused by carbonic acid gas: in that case the blue color returns when the paper is washed and held to the fire.

Blue litmus-papers may be changed to the red papers used for alkalies by soaking in water acidified with sulphuric acid, one drop to half a pint.

THE SALTING AND ALBUMENIZING PAPER.

Take of

Chloride of ammonium, or pure chloride of sodium	-	200 grains.
Water	- - - - -	10 fluid oz.
Albumen	- - - - -	10 fluid oz.

If distilled water cannot be procured, rain water or even common spring water* will answer the purpose. To obtain the albumen, use new-laid eggs, and be careful that in opening the shell the yelk is not broken; each egg will yield about one fluid ounce of albumen.

When the ingredients are mixed, take a bundle of quills or a fork, and beat the whole into a perfect froth. As the froth forms,

* If the water contained much sulphate of lime, it is likely that the sensitiveness of the paper would be impaired (?).

it is to be skimmed off and placed in a flat dish to subside. The success of the operation depends entirely upon the manner in which this part of the process is conducted; if the albumen is not thoroughly beaten, flakes of animal membrane will be left in the liquid, and will cause streaks upon the paper. When the froth has partially subsided, transfer it to a tall and narrow jar, and allow to stand for several hours, that the membranous shreds may settle to the bottom. Pour off the upper clear portion, which is fit for use. Albuminous liquids are too glutinous to run well through a paper filter, and are better cleared by subsidence.

A more simple plan than the above, and one equally efficacious, is to fill a bottle to about three parts with the salted mixture of albumen and water, and to shake it well for ten minutes or a quarter of an hour, until it loses its glutinosity and can be poured out smoothly from the neck of the bottle. It is then to be transferred to an open jar, and allowed to settle as before.

The solution, prepared by the above directions, will contain exactly ten grains of salt to the cunce, dissolved in an equal bulk of albumen and water. Some operators employ the albumen alone without an addition of water, but the paper in that case has a very highly varnished appearance, which is thought by most to be objectionable.

The principal difficulty in albumenizing paper is to avoid the occurrence of streaky lines, which, when the paper is rendered sensitive, bronze strongly under the influence of the light. The writer believes these to be caused by a commencing decomposition of the animal matter composing the cells in which the albumen is retained and the best remedy appears to be to use the eggs quite fresh; the same object may sometimes (but not invariably) be attained by allowing the albumen to stand for several weeks until it has become sour; after which it will be sufficiently limpid to run through a filter.

In salting and albumenizing photographic paper by the formula above given, it was found that each quarter sheet, measuring eleven by nine inches, removed one fluid drachm and a half from

the bath, equivalent to about one grain and three quarters of salt (including droppings). In salting plain paper, each quarter sheet took up only one drachm ; so that the glutinous nature of the albumen causes a third part more of the salt to be retained by the paper.

Selection of the Paper.—The English papers are not good for albumenizing ; they are too dense to take the albumen properly, and curl up when laid upon the liquid ; the process of toning the prints is also slow and tedious. The thin negative paper of Canson, the Papier Rieve, and Papier Saxe, have succeeded with the writer better than Canson's positive paper, which is usually recommended ; they have a finer texture and give more smoothness of grain.

To apply the albumen, pour a portion of the solution into a flat dish to the depth of half an inch. Then, having previously cut the paper to the proper size, take a sheet by the two corners, bend it into a curved form, convexity downwards, and lay it upon the albumen, the centre part first touching the liquid and the corners being lowered gradually. In this way all bubbles of air will be pushed forwards and excluded. One side only of the paper is wetted : the other remains dry. Allow the sheet to rest upon the solution for one minute and a half, and then raise it off, and up by two corners. If any circular spots, free from albumen, are seen, caused by bubbles of air, replace the sheet for the same length of time as at first.

The paper must not allowed to remain upon the salting bath much longer than the time specified, because the solution of albumen being *alkaline* (as is shown by the strong smell of ammonia evolved on the addition of the chloride of ammonium), tends to remove the size from the paper and sink in too deeply ; thus losing its surface gloss.

Albumenized paper will keep a long time in a dry place. Some have recommended to press it with a heated iron, in order to coagulate the layer of albumen upon the surface ; but this precaution is unnecessary, since the coagulation is perfectly affected by the

nitrate of silver used in the sensitizing ; and it is doubtful whether a layer of dry albumen would admit of coagulation by the simple application of a heated iron.

To render the paper sensitive.—This operation must be conducted by the light of a candle, or by yellow light. Take of

Nitrate of Silver	-	-	-	-	-	-	-	60 grains.
Distilled Water	-	-	-	-	-	-	-	1 ounce.

Prepare a sufficient quantity of this solution, and lay the sheet upon it in the same manner as before. Three minutes' contact will be sufficient with the thin negative paper, but if the Canson positive paper is used, four or five minutes must be allowed for the decomposition. The papers are raised from this solution by a pair of bone forceps or common tweezers tipped with sealing-wax ; or a pin may be used to lift up the corner, which is then taken by the finger and thumb and allowed to drain a little before again putting in the pin, otherwise a white mark will be produced upon the paper, from decomposition of the nitrate of silver. When the sheet is hung up, a small strip of blotting-paper suspended from the lower edge of the paper will serve to drain off the last drop of liquid.

The solution of nitrate of silver becomes after a time discolored by the albumen, but may be used for sensitizing until it is nearly black. The color can be removed by animal charcoal,* but a better plan is to use the "kaolin" or pure white china clay. The writer has also tried the common "pipe-clay," which answered perfectly, but appeared to injure the sensitiveness of paper subsequently floated upon the bath (?).

Sensitive albumenized paper, prepared as above, will usually keep for several days, if protected from the light, but afterwards turns yellow from partial decomposition.

* Common animal charcoal contains carbonate and phosphate of lime the former of which renders the nitrate of silver *alkaline* ; purified animal charcoal is usually acid from hydrochloric acid.

Comparison of British and French Weights and Measures.

WEIGHTS.

Grain, Apothecaries'	=	0.0648 grammes, French.
Ounce "	=	31.102 "
" Avoirdupois	=	28.346 "
Drachm, Apothecaries'	=	3.888 "
<hr/>		
Gramme	=	15.4340 grains, Apoth.
Decigramme	=	1.5434 " "
Centigramme	=	0.1543 " "

MEASURES OF CAPACITY.

		<i>Cubic Inches.</i>		<i>Fluid Ounces.</i>
Litre	=	61.028	=	35.79
Decilitre	=	6.02	=	3.57
Centilitre	=	0.610	=	0.35
Millilitre	=	0.061	=	0.03
<hr/>				
		<i>Lb.</i>		<i>Oz.</i>
Killogramme	=	2		3½ Avoirdupois.

MEASURES OF LENGTH.

Metre	=	39.37 inches.
Decimetre	=	3.93 "
Centimetre	=	0.39 "
Millimetre	=	0.03 "

Cubic inch of water at 32°	=	252.45 grains.
" " mercury "	=	3425.35 "
Fluid oz. of water	=	437.50 "
" " measures	=	1.73 cub. in.
1 f. drachm	=	54.68 grains.
1 pint (New York)	=	27.68 cub. in.
1 oz. bromine	=	2½ f. drachms.
1 grain, Troy or Apoth.	=	1.097 gr. Avoir.
1 lb. Avoir.	=	7000 Troy grs.
1 "	=	7680 of its own grs.

The drachm Avoirdupois is never used except in weighing silk.

Pendulum vibrating seconds at New York = 39.102 inches.

In weighing solids, few weights are really necessary if they are properly assorted ; nothing less than half a grain is likely to be useful, and the series following will weigh any quantity from the half grain to two thousand one hundred and ten and a half grains, by differences of only a single grain.

The numbers are in grains, but the same principle may be carried out with any other denomination, whether ounces, pounds, or tons.

$\frac{1}{2}$, 1, 2, 3, 4 ; 10, 20, 30, 40 ; 100, 200, 300, 400 ; 1000, &c.

The artist should be provided with not less than three glass measures—one of a pint, graduated to ounces—one of two ounces, graduated to drachms—and one of two drachms, graduated to minims.

Lewis's Patent Glass Baths for Nitrate of Silver Solutions.—Since the foregoing pages have been in print this new article of Baths has been introduced, and will probably supersede all others now in market. They are encased in a box made expressly to hold them, and form a valuable and important improvement in the apparatus used in the various Glass processes.

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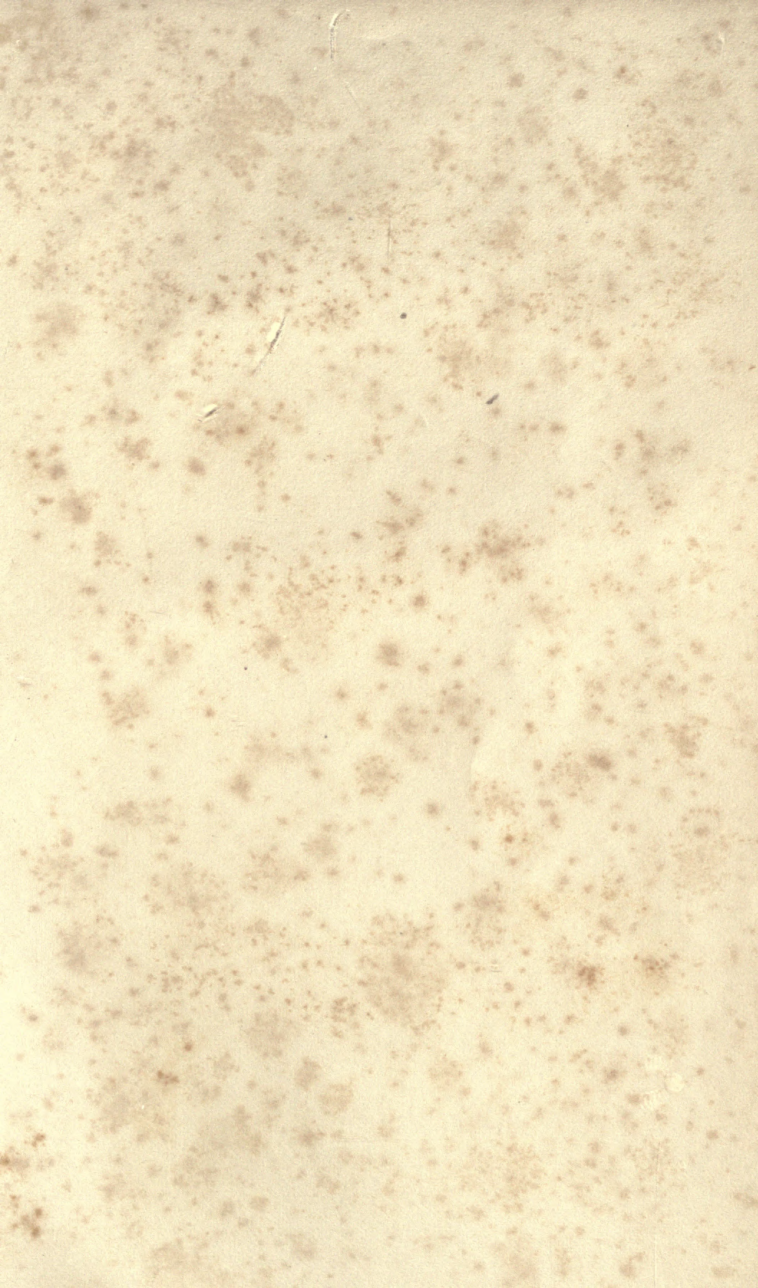
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